ARMY ORDNANCE

VOL. XXX, No. 155 MARCH - APRIL, 1946

DR. VANNEVAR BUSH

"Science must be brought to the center of the stage"

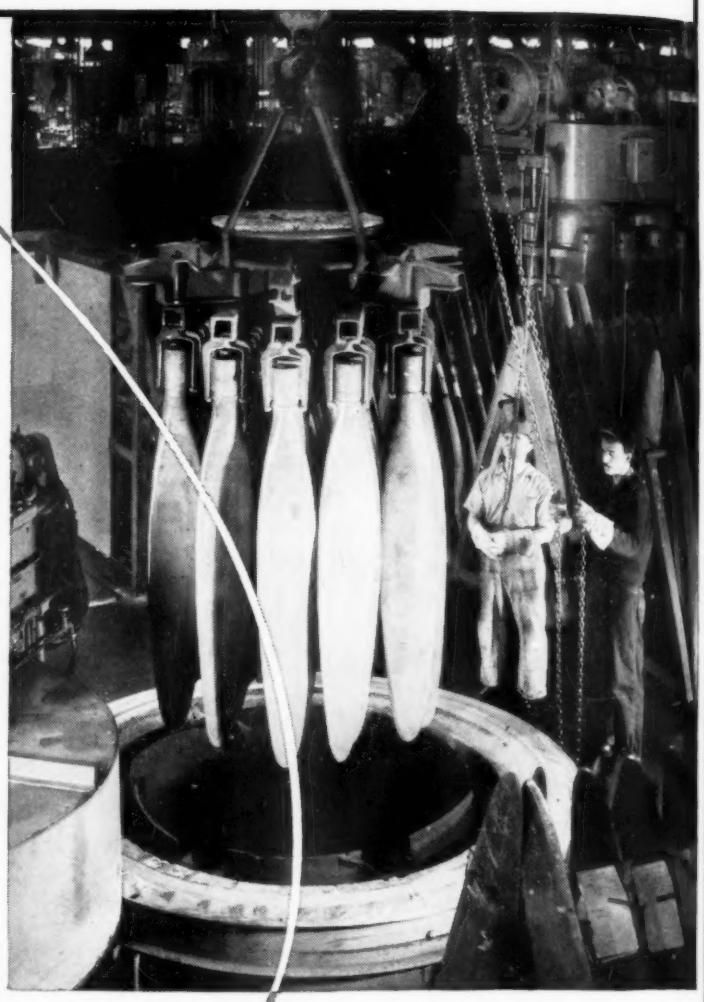
A REVIEW OF INDUSTRIAL PREPAREDNESS FOR NATIONAL DEFENSE
PUBLISHED BY THE ARMY ORDNANCE ASSOCIATION, WASHINGTON, D. C.

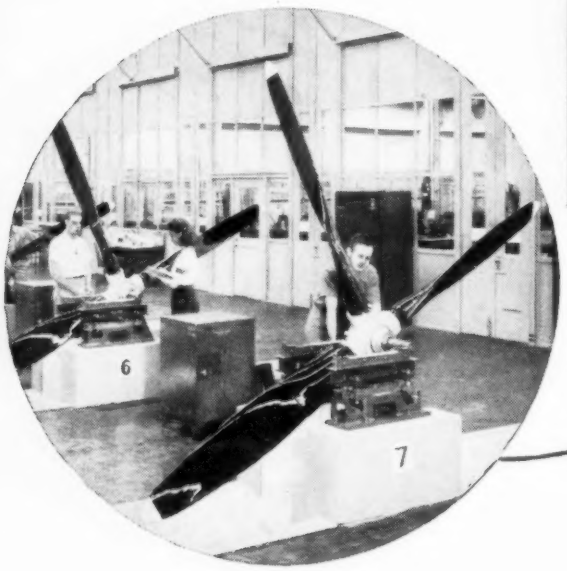
NICKEL STEELS *combine...*

EXCEPTIONAL MECHANICAL *and* FABRICATING PROPERTIES

SAE 4330 Nickel chromium molybdenum alloy steel was adopted for Curtiss propeller blades because of its high strength, toughness and good workability, coupled with a wide safe heat-treating range.

High velocity cooling is not necessary to properly harden SAE 4330 for this application. There is no warping to correct by cold-straightening operations nor danger from subsequent stresses that might cause failure in service, because the slow transformation rate of this steel permits hardening to the required degree by die-quenching; thus consequent savings in time and labor, and a uniform final product are provided.





Curtiss Propeller Division of Curtiss-Wright Corporation, one of the largest producers of constant speed propellers, fabricates blades by welding two plates of SAE 4330 into a hollow unit that permits weight saving over solid blades of light metals.

Inquiries on the use of Nickel alloy steels or other alloys containing Nickel in your products or equipment, are invited.

THE INTERNATIONAL NICKEL COMPANY, INC. 67 WALL STREET NEW YORK 5, N.Y.

ARMY ORDNANCE was entered as second-class matter, August 14, 1920, at the Post Office at Washington, D.C., under the Act of March 3, 1879. Additional second-class entry at the Post Office at Richmond, Va.

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Issued bimonthly. Single copy, 75¢ (by mail). Subscription rate: U.S. and possessions, $4.50 annually, in advance; foreign, $6.00.

PAST, PRESENT AND FUTURE...

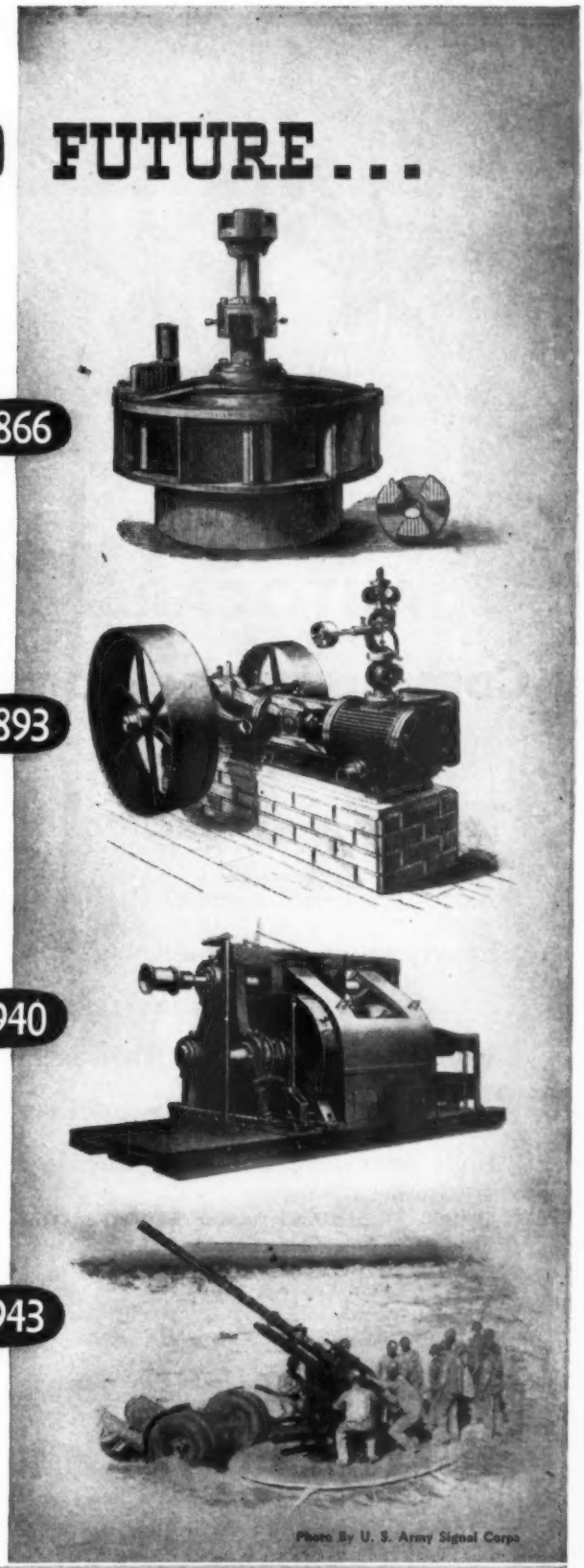
IN 1866, machine tools as we now know them existed only in the minds of highly imaginative men. In those days it was necessary to chip and file almost every machine operation by hand.

Yet 80 years ago, we made Water Wheels, Cane-Mills, Sawmills and Engines that were noted for quality, good workmanship, and resulting long life.

We could not have weathered the depression storms of over three quarters of a century if we had deviated from the principles established by our Founder. He would not make something to sell for less if it meant any sacrifice of quality.

We are thankful for the exacting standards and requirements of our Army Ordnance and Maritime Commission. To win this war, our equipment had to excel that made by our enemies, and in doing our part of it, we learned much that will be reflected in the machines we are building for Peacetime use.

NOTE: The Water Wheel and Engine pictures reproduced here are from wood cut illustrations in Wheland Catalogs issued in 1877 and 1893 respectively.



THE WHELAND COMPANY

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AUTOCARS
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Heavy-duty, precision-built Autocar Trucks make light of heavy going. They haul big payloads safely and dependably...and *with five-star authority.* This extra ruggedness makes Autocars deliver high operating efficiency and low operating costs—two factors that mean profitable hauling.

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New Developments

ANTISUBMARINE METHODS

Some of the gadgets and tactics that whipped Germany's submarines can now be disclosed, because already they are obsolescent.

The Sonobuoy, a small buoy tossed overboard from plane or ship in the vicinity of a submarine, gets the sub's location by sound waves and automatically transmits the information to plane or ship by radio. Sonar equipment (of which the Sonobuoy is a part) does under the water what radar does in the air. Germany, the Navy is convinced, was completely surprised that the allies had such equipment when the war started. A world-wide network of radio stations to get cross bearings on U-boats was established. To the end of the war the allies kept tuned in on the sub skippers' conversations.

German development of a new, high-speed U-boat in the last months of the war changed the whole concept of antisubmarine warfare. This means our former tactics, based largely on keeping them under the water, are outmoded. The German boat can make twenty-five knots—fast enough to get through our screens and at our convoys. Because bombing interfered with construction, none of the fast subs got into action, but several were afloat at the end of the war. It has been called the first real submarine, one that can make better time under the water than on the surface.

NONPETROLEUM WINTER MOTOR OIL

A nonpetroleum war-tested motor oil for automobiles and aircraft engines will be on the market in limited areas soon. The new product flows freely at thirty degrees below zero Fahrenheit, does not thin out at high temperatures, and provides efficient lubrication of the moving parts when the engine is running, it is claimed. It is a chemically created oil that resembles ordinary motor oil.

1,400 MILES AN HOUR

The Curtiss-Wright Corporation announced some time ago it had developed several special devices which were achieving speeds in excess of 1,400 miles an hour—almost twice the speed of sound. Dr. C. C. Furnas, director of the Curtiss-Wright research laboratory, said military requirements prevented him from giving any details about the devices. He said, however, that "they are not rockets, and they are not artillery shells.

"Right now the devices are not carrying pilots, but we are working on this," Dr. Furnas said, adding: "We think the value of this development will be largely military. Such speeds are too fast for commercial use, although if any one wanted to pay enough to go that fast we probably could make it possible within twenty years."

Dr. Furnas also announced the development of a telemetering system whereby the performance data of an object in flight could be recorded at a mobile receiving unit. He said this had enabled them to study the instruments and performances of the special flying devices while they were traveling at supersonic speed.

NEW APPROACH-ANGLE INDICATOR

A new approach-angle indicator for airport landing has been developed which uses only a 100-watt incandescent bulb to project a tricolor beam over a one-mile range indicating the correct

TO TRIM THE COST OF PARTS . .

All of these parts are made from Shelby Seamless Tubing.

1. and 4. Clutch bearing shells
2. Roller for conveyor
3. Spacer for bearings
5. and 6. Airplane engine suspension parts

Re-design with SEAMLESS TUBING

By using Shelby Seamless Tubing instead of forgings or pieces bored from solid stock, sizeable reductions in cost can be made in manufacturing finished parts.

With Seamless Tubing, the basic shape is already made which eliminates at least one step in manufacture. The uniform high quality and proved machinability of the steel permit fast machining and reliable parts can be turned out on a mass-production basis.

Shelby Seamless Tubing is available in any size from ⅜ inch to 10½ O.D. inches and in wall thicknesses from .035 inches to 1.500 inch cold drawn. NATIONAL Tube Company engineers and metallurgists will be glad to help work out methods for faster production of parts at lower costs. Write for details. There is no obligation.

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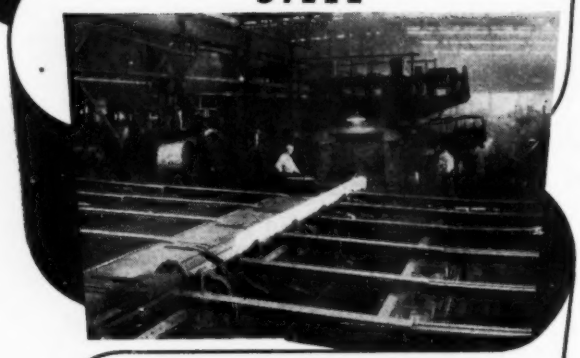
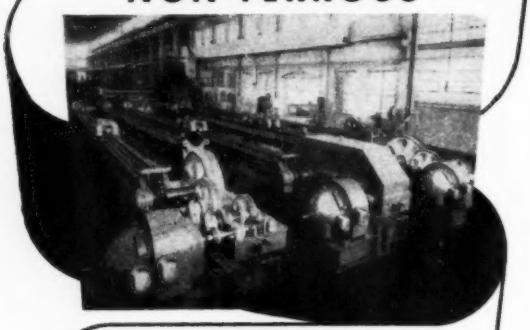


NON-FERROUS



AND OTHER INDUSTRIES

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JOHN INGLIS COMPANY, LIMITED
TORONTO, ONTARIO, CANADA

angle of approach. The new indicator sends the light through seven lenses, breaking it up into green, red, and amber beams. The green beam indicates the correct angle of approach, the red or lowest beam warns the pilot that he is too low, and the yellow or upper beam tells the pilot that he is too high. To avoid possibility of glare and confusion with other lights, the beams flash on for one second and off for a half second, controlled by a motor-driven shutter to insure sharp cutoff.

SUBMARINE AIMING BINOCULAR

A submarine binocular that doubles as an aiming sight for torpedoes as well as for deck guns can now be revealed. Designed and manufactured by Bausch & Lomb Optical Company, the instrument was used against Japanese shipping during the final phases of the war. The binocular weighs forty pounds and remains on deck when the submarine submerges.

Mounted on a device called a target-bearing transmitter, the binocular made possible the sighting of enemy vessels in dim light and the quick, accurate firing of a torpedo from any position without turning the submarine.

When an enemy vessel was sighted while the submarine was cruising on the surface, the binocular was swung and adjusted so that the cross lines were centered on the ship. This setting registered on a computing machine below deck. The torpedo's gyroscopic steering device was set according to the computation and the torpedo fired. Going through the water, a torpedo can turn in a curve up to ninety degrees to find its mark.

GERMAN AIR PURIFICATION

Air-purification devices developed in Germany for use in submarines, especially in the one- and two-man U-boats, appear to be well ahead of Western allied developments, according to American official investigators who visited Germany under the sponsorship of the United States Government. Development work by the Draegerwerk (Draeger factory), at Luebeck was investigated particularly, especially work on air-purification devices for underwater craft and for high-altitude demand regulators.

FLYING WING ROCKET SHIP

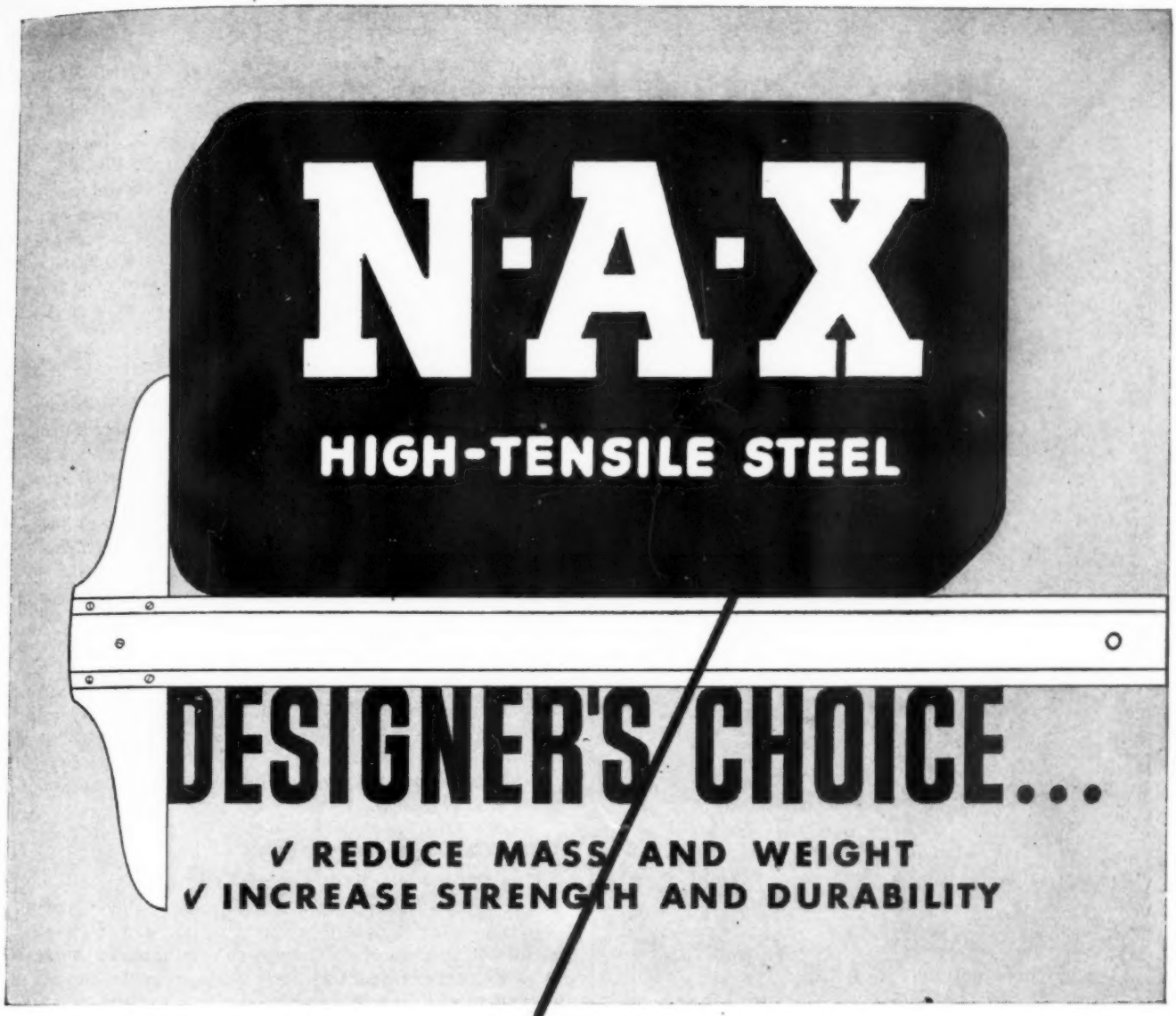
Rocket-propelled "Project 12," previously a Wright Field secret, is a flying-wing type of aircraft in which the pilot lies on his stomach, his chin on a V-shaped rest, and looks out through a plexiglas nose faired into the wing's leading edge. In the prone position he is best able to bear the increased accelerations which great speed entails. Built by Northrop, the wing blazed a trail for the new XP-79, jet-propelled, flying-wing fighter.

Controls of "Project 12" are hooked up to a handle bar. When the handles are upright, control surfaces are neutral. The pilot bends the handles forward to nose down, backward to nose up, and to right or left to bank the wing. To turn, he moves the handle bar as if he were steering a motorcycle. The throttle is within easy reach of his left hand, and other switches are near his right. The pilot enters the wing through a hatch in the top, which has an automatic opening device for emergency bail-out.

THE AZON GUIDED MISSILE

Details of the "Azon" bomb—another secret weapon of World War II—can now be revealed. Azon is the standard 1,000-pound demolition bomb which has a "radio brain" attached. This enables the bombardier to sight the missile on his Norden bombsight and let it go. Once the bomb is dropped, the bombardier continues to guide it in azimuth (right or left of the target) by remote control.

A 1,000,000-candlepower flare on the tail of the Azon is automatically ignited by a fuze after it leaves the plane. Merely by following it with his eye, the bombardier can detect errors in



By taking advantage of the high inherent properties of N-A-X HIGH-TENSILE steel—great strength and toughness, exceptional formability, outstanding resistance to impact and fatigue, with good weldability and resistance to corrosion—manufacturers can have their choice of two fundamental improvements in product design:

1 Where reduction of weight means efficiency, lighter sections of N-A-X HIGH-TENSILE steel can be used without sacrifice of strength. Its high properties take the place of mass.

2 Where increased strength and life characteristics are desirable, the use of N-A-X HIGH-TENSILE steel in the same sections will provide a stronger, tougher, longer-lasting product.

Certainly these demonstrable advantages are worthy of your consideration in the conquest of postwar markets.

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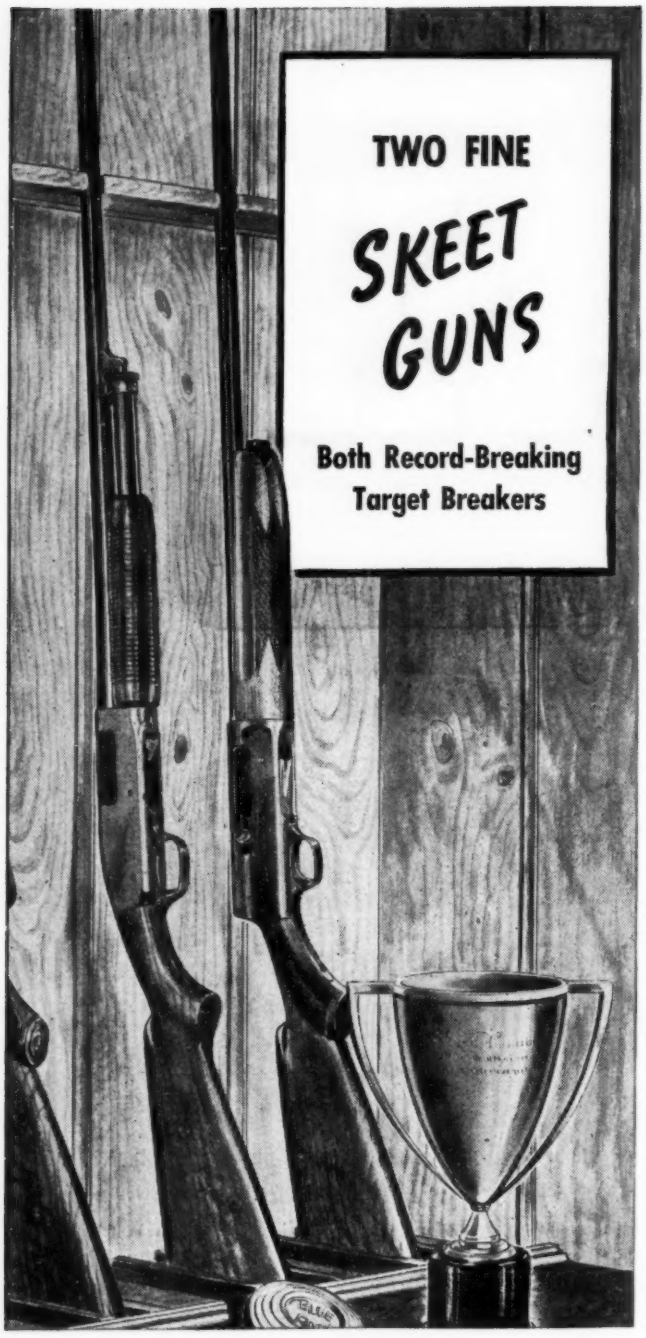

Whether you prefer an autoloader or a pump gun, you'll find a Remington the *right* gun. The Remington Model 31 (left) pump-action, repeating shotgun was nicknamed "the gun with the 'ball-bearing' action" by aerial gunnery students, because of its velvety-smooth operation. On the right is the Remington Sportsman, a 3-shot autoloader—points as naturally as your finger.

Keep an eye on the high gun shooters at tournaments. Notice how many of them win with Remingtons. For FREE literature, write Remington Arms Company, Inc., Bridgeport 2, Conn.

Remington

DUPONT

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Sportsman is Reg. U. S. Pat. Off. by Remington Arms Company, Inc.

New Developments

azimuth as small as 5 or 10 feet from an altitude of 15,000 feet. He corrects them merely by pushing the handle of the control box in the aircraft to right or left.

This successful guided missile of the Army Air Forces was first introduced to the Japanese on December 27, 1944, when a 3-span steel railway bridge on the rail line between Rangoon and Mandalay was destroyed by the 7th Bomb Group of the Tenth Air Force. While this weapon was useful to achieve its purpose during the period of its use, American research and development have produced and are continuing to develop newer types of guided missiles which make those such as Azon obsolescent.

COLD TEST ROOM

A new cold room in which rubber and synthetic rubber compounds and products of many types, plastics, and other materials can be tested at temperatures down to ninety degrees below zero has been installed by the B. F. Goodrich Company at its Akron, Ohio, plants. Thirty feet long, fifteen feet wide, the cold room has five working units, each six feet square, cooled by a 3-stage compressor unit and a single-stage compressor using Freon 12 and 22 as refrigerants. Each unit operates separately, with electrically controlled temperatures charted for a 24-hour study at different levels.

Capable of taking a load of 250 pounds of rubber, synthetic rubber, or plastics, 500 pounds of steel, or 100 pounds of oil, each unit is equipped with a door having a nonlocking catch and an alarm operated from within the unit as further protection against locking in the operator. All operators wear electrically heated clothing. Four of the units have temperature ranges from 50 above to 65 degrees below zero, while the fifth has a range from 50 above to 90 below.

MIDOCEAN AIRDROMES

A new British invention seems to remove all limitations on the size of midocean airports. The invention, termed the "Lily" because of its resemblance to a carpet of lily leaves on a pond, consists of numbers of buoyancy cans with hexagonal surfaces, so linked together that they "give" in a controlled manner to the motion of the sea from any direction. Yet these hexagonal surfaces, because they are put in tension when linked together, are rigid enough to uphold heavy aircraft. The surface of the landing strip is so flexible that it will not break up, but this flexibility is controlled by underwater dampers. It is necessary to apply more than three tons' pressure to move the surface at all, and the inventor claims that "Lily" will remain usable in waves up to thirty-six feet from crest to crest.

DAYTIME CELESTIAL NAVIGATION

A daylight celestial sighting device, making possible celestial navigation by day, has been perfected by the Air Forces Board, Orlando, Fla. The instrument as originally produced consisted of an optical lens two inches in diameter with a focal length of twelve inches. Attached to the lower end of the tube was an eyepiece turret with 3-eyepiece mount giving 10x, 20x, and 40x magnification. Shades were attached to cut down sun glare. A prism placed within the tube bent the light rays through ninety degrees making observation of the stars in daylight possible.

"GUIDED MISSILES" BATTALION

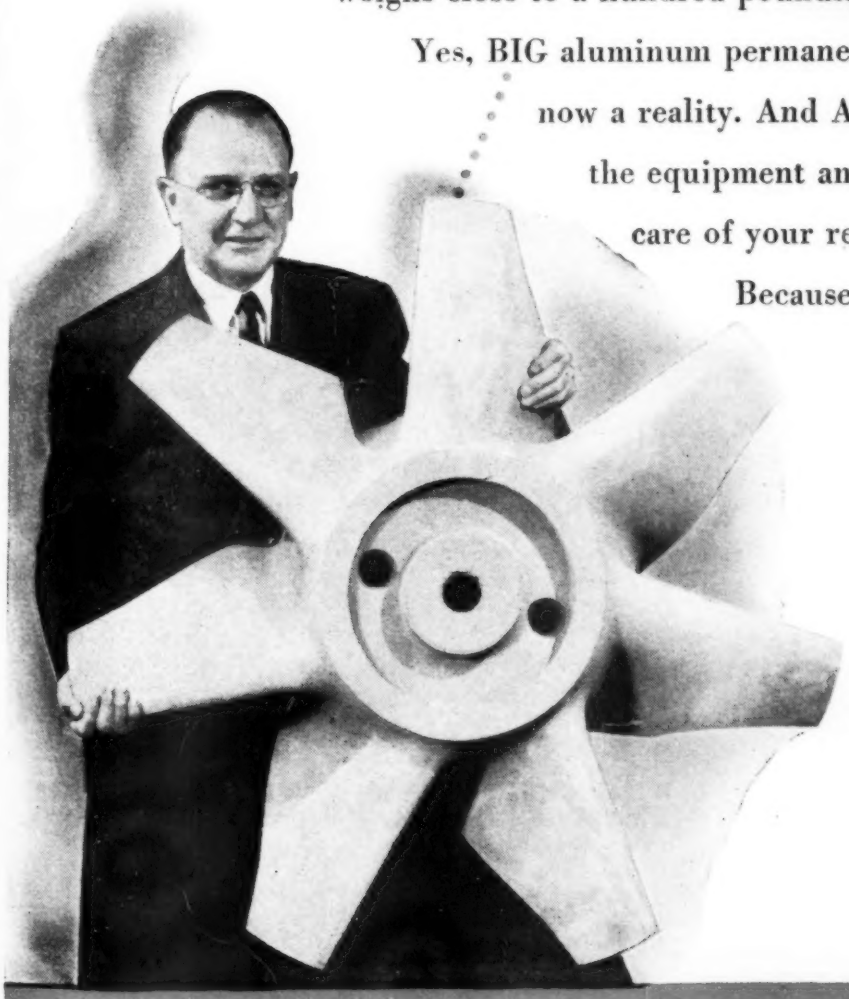
Organization of a special ground troops' unit to keep actual military use of long-range missiles abreast of scientific development in this field has been announced by Gen. Jacob L. Devers, Commanding General of Army Ground Forces. The newly created "guided missiles" battalion will provide tactical troops to test and evaluate succeeding experimental models of new supersonic weapons as they come from the laboratories of various units now working on their development, the announcement

The hat trick was a good one, but ...

Alcoa Aluminum Permanent-Mold Castings long ago outgrew the "small" category

Do you still think of permanent-mold castings as "small enough to put in a derby hat?" The war changed that. The blower impeller shown here is typical of products made by this process. It weighs close to a hundred pounds.

Yes, BIG aluminum permanent-mold castings are now a reality. And Alcoa has the know-how, the equipment and the capacity for taking care of your requirements.



Because Alcoa permanent-mold castings carry little excess metal, they cut down finishing time and help speed your production. Aluminum Company of America, 2137 Gulf Building, Pittsburgh 19, Pennsylvania.

ALCOA FIRST IN ALUMINUM

ALCOA ALUMINUM

WORLD-WIDE CONTINENTAL POWER

Yesterday, Continental Red Seal Engines, mounted in landing craft, tanks and other war machines, provided the driving force which hastened the end of the war. Today, proven Red Seal Engines — dependable and economical — are rolling off Continental production lines. Red Seal Engines for farm tractors, highway trucks and industrial equipment are speeding the return to normal living. If it's power you need, you'll find a Continental engine to meet your requirements. Red Seal Engines, gasoline or Diesel, from 5/8 to 251 horsepower, are on the job wherever there's work to be done.

Continental Motors Corporation
MUSKEGON, MICHIGAN

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It Identifies the Finest
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said. A second mission assigned to the new unit will be to develop tactical plans for the employment of the new missiles. In this way, it was pointed out, the battalion will supplement rather than duplicate scientific research.

Indicating the need for such a unit to keep tactical pace with technical developments, the announcement cited the great increase in the effectiveness of traditional artillery weapons during World War II through use of radar, the proximity fuze, improved computing devices, and similar scientific advances for achieving greater accuracy. The new unit will keep military usage abreast of developments in the field of guided missiles, the long-range artillery weapons of the future.

NAVY P2V PATROL BOMBER

The Lockheed P2V, the Navy's new "peace patrol plane," has advanced design and engineering which give it—with just two engines—the carrying load and range of World War II 4-engined bombers such as the B-17 and B-24. The P2V is the first land-based plane ever designed for the Navy for the specific job of patrol. It has the greatest range, fastest speed, and heaviest armament of any patrol and search bomber yet developed.

It can fly nonstop observation missions of more than 5,000 miles—sufficient range to travel from Pearl Harbor to New York in one hop, from Tokyo to Seattle without refueling, or nonstop from Washington to Moscow. It performs equally well at high and low altitudes and can fly at more than 300 miles an hour, a rate swifter than that of any other Navy patrol ship. It carries more than 2,000 pounds of radar equipment of the very latest type developed since Pearl Harbor.

In event of surprise attack or unexpected uprising, it can transform itself instantly into a deadly attack-bomber with its versatile bomb bay fitted for atomic bombs, two 2,165-pound aërial torpedoes, four of the new 11.5-inch Tiny Tim aërial rockets, sixteen 500-pound bombs, eight 1,000-pounders, four 2,000-pounders, or twelve 325-pound depth charges. In addition, it can fire sixteen 5-inch high-velocity aircraft rockets from underwing launchers—twice as many as any patrol plane has carried previously. Six 20-mm. cannon fixed in the nose give the P2V unprecedented forward firing power. It also has twin-mount caliber .50 machine guns in the top turret and the power tail turret to cover all angles.

AMPLIFIER FOR RADAR

Some radar sets, having found a target, tenaciously follow it. The reflected signal picked up by the antenna may be as little as eight-thousandths of a watt. This energy is far too small to operate the motor that must keep the antenna pointed at the target, so some amplifying device is necessary. A servo-generator developed for this purpose consists of an exciter and a D.C. generator, both driven by an A.C. motor. The feeble radar signal is electronically amplified and is fed to the exciter which amplifies it further and sends it to the fields of the D.C. generator. This generator provides another amplification, delivering sufficient power to the motor driving the antenna. The polarity and magnitude of the generator voltage and hence the direction of rotation and speed of the antenna motor are governed by the differences of current in the exciter field coils.

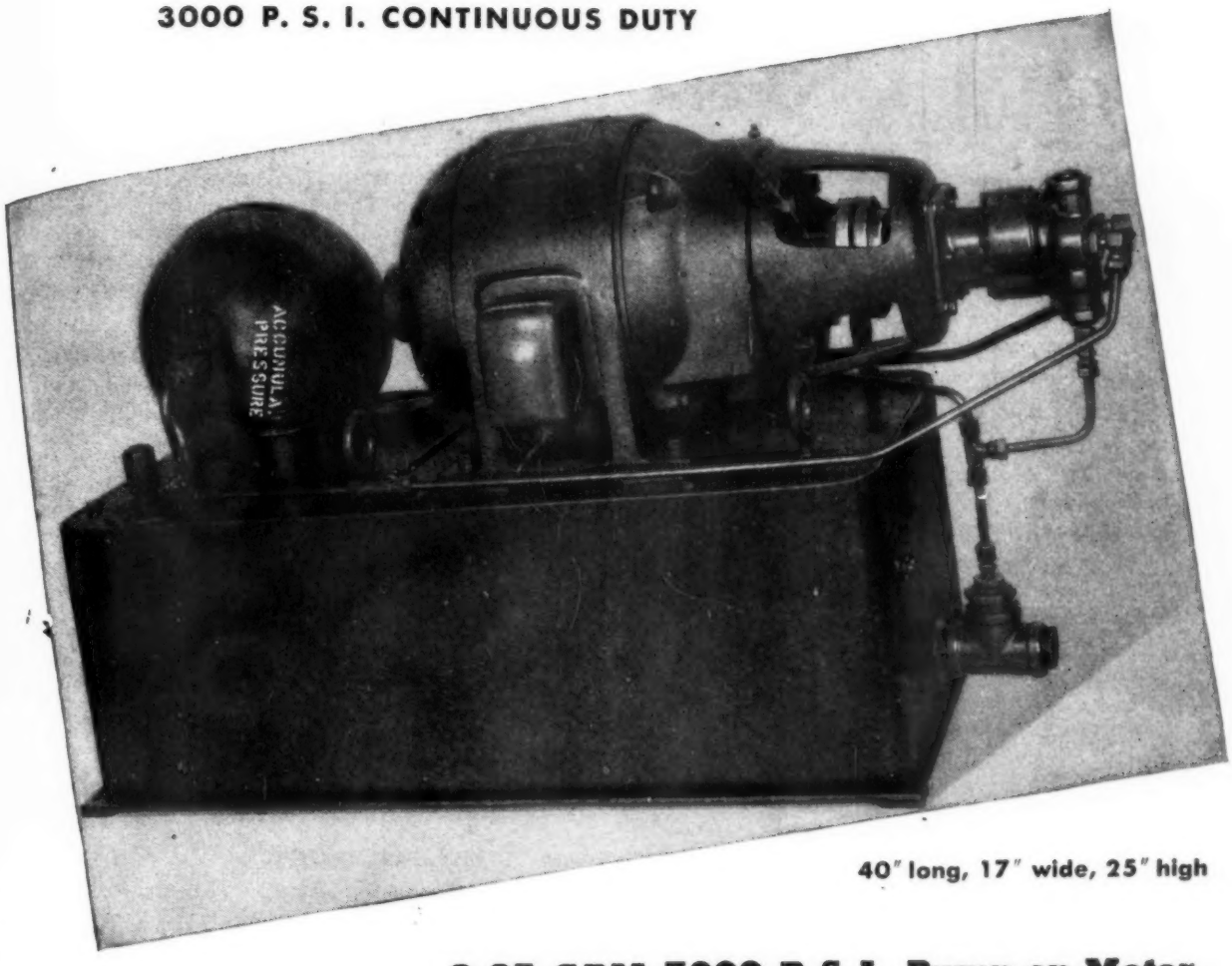
ELECTRONIC STORM LOCATERS

Development of an electronic static direction finder which enables weather forecasters to plot the locations of distant storm centers across thousands of miles of ocean by detecting the static electricity in thunderstorms, cloud masses, or rainfall can now be disclosed. The finder has formed the basis for a new field of meteorology known as "spherics"—a contraction of "atmospherics."

Spherics is based upon the principle that most atmospheric disturbances are accompanied by electricity, commonly referred

HYCON
POWER UNIT

3000 P. S. I. CONTINUOUS DUTY



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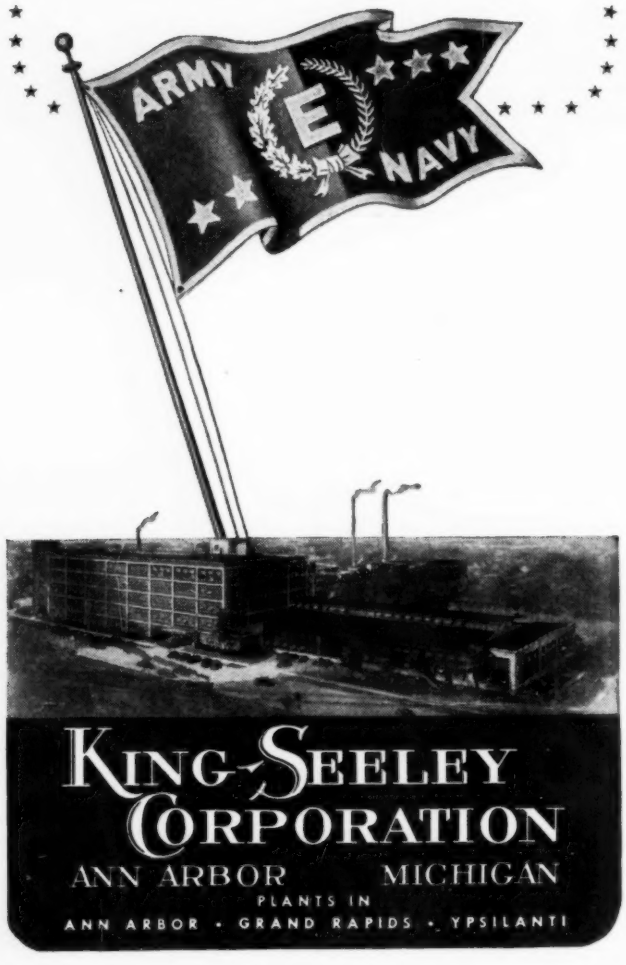
KING-SEELEY'S Service Record

The records show that between February, 1941, and August, 1945, King-Seeley employees produced and delivered to our Armed Forces more than 385,000,000 pieces of special war materials. In addition to this, more than 1,000,000 pieces of regular production items such as governors, gauges, and speedometers for both combat and supply vehicles were produced.

We feel justly proud of this record and the sixth Army-Navy "E" Award given us May 12, 1945, in recognition of this accomplishment. If necessary, we can do it again, but right now we are devoting all our energy to the production of peacetime civilian goods to the end that all may enjoy true prosperity.



KING-SEELEY CORPORATION
ANN ARBOR MICHIGAN
PLANTS IN
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to as static. When static is detected from a distance, it may be assumed to indicate the existence of a storm. Thus meteorologists now are able to plot the locations of storms over large areas without the necessity of making on-the-spot observations of the weather throughout those areas.

The direction finder consists essentially of two stationary-loop receiving antennas at right angles to each other, a powerful amplifying system which magnifies the received impulse, and an oscilloscope similar to those used in radar and television. The amplified static impulses are applied to the plates of the oscilloscope to create flashes of light on its face.

The position of the flash on the 'scope indicates the direction of the static source, and the circumference of the face is calibrated to facilitate determination of the compass direction. When the precise direction of the static source is known in relation to two or more such receivers, the location of the disturbance may readily be plotted on a map by means of triangulation. The detectors have a dependable range of 2,000 miles and are accurate to within 2 degrees.

NEW AIRPLANE INSTRUMENT SYSTEM

A new teamlike electrical system of instruments now for the first time will give an airplane sustained and pin-point directional accuracy in flights controlled by autopilots without the necessity of gyroscope corrections being made by pilots or navigators, except for wind drift deviations. One of the major advances in the new method, which harnesses the compass and gyroscope into a steady computing unit, is that errors which normally would crop out in either of those instruments operating separately are corrected automatically.

A factor of minor error in autopilots operating without the new system is that the compass vibrates slightly, with the needle flicking back and forth over the true directional line. When those vibrations are balanced, the compass line is accurate. However, an autopilot answering the compass directly tends to edge off the predetermined line of flight of the plane at fractional angles. The new system of coördinating through an electrical coupling of the compass and gyroscope eliminates those errors.

NEW AXIAL-FLOW JET

Shaped like a streamlined torpedo, a new axial-flow turbo-jet engine has been developed by General Electric Company to drive military and civilian planes at great speeds on long flights. Said to be more powerful at high speeds than any conventional engine in the air today, this axial-flow jet marks definite improvements in aërodynamic design and fuel consumption, opening the way to greater range and more economical operation of airplanes than previously has been possible with power generated by turbo jets.

Known in the AAF as the J-35 and industrially as the TG-180, this engine is long and light in comparison with reciprocating engines. The frontal area of the axial-flow jet is far less than for any reciprocating aircraft engine now used on large airplanes.

NEW RUNWAY LIGHTS

Among the many new developments for greater flying safety to have their debut at New York City's Idlewild Airport, largest of all airports, are two novel methods of marking runways for night use. The edges of one of the nearly two-mile-long runways will be marked by a veritable curtain of light by an entirely different type of light unit.

The unit comprises two light sources mounted in a cabinet about two feet high and located just off the runway apron. One is a conventional "contact light" which throws a flat beam along the edge of and into the runway. The other is a sealed-beam lamp behind a prismatic lens, often used in marine installations. This lens sends skyward a narrow fan of light. With these units

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BATTERIES

built by the organization that makes complete electrical systems for many of America's finest cars, trucks and tractors

MONEY CANNOT BUY A BETTER BATTERY

For more than 35 years, the name Auto-Lite has meant automotive ignition and electrical parts of the highest quality. Standard equipment for many of America's finest cars, trucks and tractors, Auto-Lite batteries, spark plugs, instruments and gauges, warning signals, lights and complete automotive electrical systems have established a world-wide reputation for dependability in service.

Auto-Lite engineering and precision manufacturing insures the fact money cannot buy better, more dependable equipment. A new booklet listing many of the major products of The Electric Auto-Lite Company is just off the press. To obtain your copy, write to

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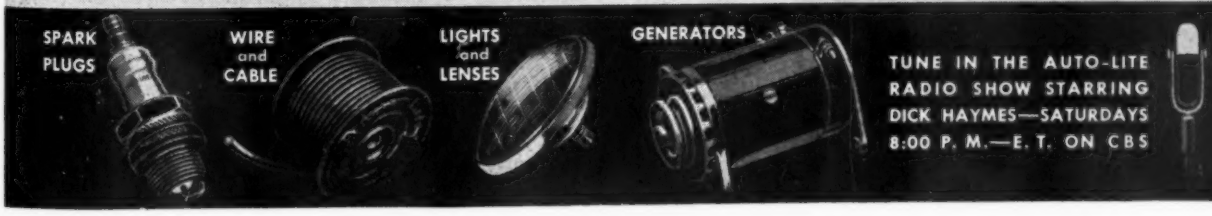
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spaced 200 feet apart along each edge of the runway, the incoming pilot finds the proper runway unmistakably marked between two curtains of light even during some fog conditions.

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RADAR REFLECTOR

A tiny radar device known as the "corner reflector" weighing slightly over a pound enables lifeboats carried on Army Air Forces overseas missions to be as easily detected as a flashlight in a blackout.

A cloth mesh woven of monel metal is the important feature of the reflector, which is attached to a mast extending from the raft. This mesh reflects radar waves transmitted by the searching aircraft. The radar scope within the plane picks up the reflected waves, thus revealing the exact position of the downed victims.

JET FIGHTER FOR CARRIERS

The first Navy fighter plane powered exclusively by jet engines and designed for carrier operation is the XFD-1 Phantom built by the McDowell Aircraft Corporation. Already extensively flight-tested, the new XFD-1 has a service ceiling of well over 7 miles and is the first Navy fighter to attain speeds in excess of 500 miles an hour. Primarily designed as an interceptor, it has an extremely high rate of climb and a range of approximately 1,000 miles. This plane constitutes a significant milestone in the history of naval aviation as it opens the field of carrier operation to the all-jet interceptor. Power is furnished by twin axial-flow turbo-jet engines built into the wing roots.

A single-seat, low-wing monoplane of conventional monocoque design, the Phantom has a wing span of approximately forty feet. The wings fold electrically, and when rigged for stowage the plane is but sixteen feet wide. Rocket devices and auxiliary belly fuel tanks may be dropped in flight.

NEW SPORTING GUN SIGHTS

A new and revolutionary type of gun sight for sporting arms which projects an illusionary but nonetheless definite bull's-eye pattern into the sky and around the target has just been placed on the market. With this new gun sight, known as Nydar, it is not necessary to squint or use "one-eye" sighting. The hunter merely throws up his gun, glances through the reflector plate to see that the projected ring and dot are on the target, then fires. The projected ring promotes much greater accuracy in "lead" shooting, and the dot enables the hunter to get his range accurately, thus preventing wasting of shells and crippling of game. The Nydar sight is built around precision optics, is constructed of blue steel, can be mounted on both breakdown and automatic types of shotguns, and sells for $27.45.

LIGHT, POWERFUL MAGNET

A new type of small, light, but powerful magnet made of iron oxide ore and cobalt oxide has been developed. It has been used in highly sensitive aircraft meters and in other wartime devices and now will be available for general civilian uses. It is claimed to be the lightest magnet ever made.

HAWKER TEMPEST II

Designed by Hawker Aircraft, Ltd., the British fighter, Tempest II, is a great improvement on the Hawker Tempest which came off the secret list over a year ago and proved to be

View of Upper Water Shops at Springfield Armory in 1830

1812 and Now

For many years after the Ordnance Department was established by an Act of Congress in 1812, its facilities were housed in a few small armories, such as those at Springfield, Massachusetts, and Harper's Ferry, Virginia.

Today, the Department not only has its own great modern armories and scientific laboratories, but commands, in time of war, the largest manufacturing and service organization the world has ever seen.

During World War II, the Ordnance Department converted approximately half of America's civilian industry to war production. AC is proud to have been one of the organizations selected for that tremendous task. The extent of AC cooperation is proved by the fact that AC built many millions of 459 ***kinds*** of war materiél—and is still making certain Ordnance products to the exacting Ordnance Department specifications.

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even faster than the Spitfire. The plane is a low-wing, single-engined single-seater, with a single fin and rudder. It is powered by a Bristol Centaurus V engine of more than 2,500 horsepower driving a Rotol 4-bladed constant-speed propeller. Its armament consists of four 20-mm. cannon in the wings. Other details are: span, 41 feet; length, 33 feet, 6 inches; height, 14 feet, 6 inches; wing area, 302 square feet; and weight, about 11,000 pounds.

IMPROVED FOG-DISPERSAL SYSTEM

An improved method of fog dispersal that facilitates the taking off and landing of airplanes in weather conditions that otherwise would suspend flying operations has been developed by the Babcock & Wilcox Company. The method is based on the application of heat obtained from burning Diesel fuel oil. The first installation of this system is being made at the Naval Auxiliary Air Station in Arcata, Calif.

While this system was developed as a war measure, it has been proved to have definite peacetime uses in that it is believed to be the most effective and economical method yet devised for clearing fogbound areas and restoring visibility to airplane pilots and ground operations at airports. It may be installed at any airport with a minimum of disturbance to aircraft operations on the field. The system operates through a series of burners. Instantaneous combustion or rapid stoppage of burner operation is obtained, since the burners are ignited electrically at will from the control tower. They burn with a bushy flame of intense heat with complete combustion, giving off a minimum of smoke while in actual operation or in shutting down.

NEW TAILLESS AIRPLANE

An unusual British tailless airplane, appropriately named the Manx, which offers attractive possibilities for the use of jet propulsion, has been built by Handley Page, Ltd., makers of the Halifax bomber. Its purpose is to permit flight research on the many problems connected with this unorthodox type of machine. Instead of a tail the Manx has its wings swept back sharply with rudders, which move in an outboard direction only, mounted on the wing tips. The ailerons act also as elevators and are known as elevons. The machine has a tricycle-type undercarriage, the main wheels of which are retractable. The engines are installed in the wing and drive variable-pitch pusher propellers. They are linked to the engines by extension shafts. Cruising speed is 150 miles an hour and ceiling about 15,000 feet.

STEAM FOR BUZZ-BOMB LAUNCHING

Application of steam propulsion in a new field has been achieved by an American company in perfecting a system for launching the buzz bomb by boiler-developed power. Only the German collapse following the failure of the Ardennes breakthrough prevented the development having active combat use in World War II. The Germans had developed a chemical means of launching their bombs, but it involved considerable hazard to the operating crew. They never succeeded in devising a safe and reliable launching means, and reports have indicated that casualties among the German gun crews were very heavy. Steam power materially reduced the launching hazard. What the company did was to design and manufacture equipment to provide high-pressure steam in sufficient quantity to accelerate a load of 5,000 pounds to a velocity of 250 miles an hour within a distance of 150 feet, the travel of the German-made ramp.

BRITISH METEOR SET RECORD

A British Meteor jet plane driven by two Rolls Royce Derwent gas-turbine engines and piloted by Eric Greenwood of the Gloster Aircraft Company established a world air speed record of 606 miles an hour. This was the Meteor's average speed in four runs over a test course at Herne Bay off the south coast of England.

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FOR A VIRILE ARMAMENT PROGRAM

THE EDITOR.—Now that the war is over and censorship lifted, it is about time that the Army Ordnance Association publications initiate an aggressive, straightforward program for more rapid and practical attainment of the constitutional objectives of the Association. It is common knowledge that practical, progressive attainment in any line of endeavor requires a constant stream of criticism and controversy, without which any person or group becomes retrogressively effete and ineffective.

The beginning of peacetime armament development requires, first, sufficient congressional appropriations each year. The first objective of the A.O.A., therefore, should be to promote such adequate appropriations. These failing, the A.O.A. publications and membership should shout loud, long, and critically of those individual members of Congress who defeat such appropriations.

As I see it, our outmoded form of separate services (Army, Navy, Air Corps) will never *each* secure adequate design-development appropriations in peacetime, as the total of such appropriations will have to be spread far too thin to enable any one service to do an adequate job. Only by a consolidation of all services, at least as far as armament design-development and supply and procurement are concerned, can we hope for adequate peacetime appropriations, especially in view of the huge Federal debt and budget facing us for the next few generations.

The second step, after adequate yearly appropriations for peacetime armament development, should be for the A.O.A. to demand and promote aggressively a program to be sure that our peacetime armed forces assign to such armament development only those officers who are fully capable, aggressive, and with the kind of character which accomplishes or resigns.

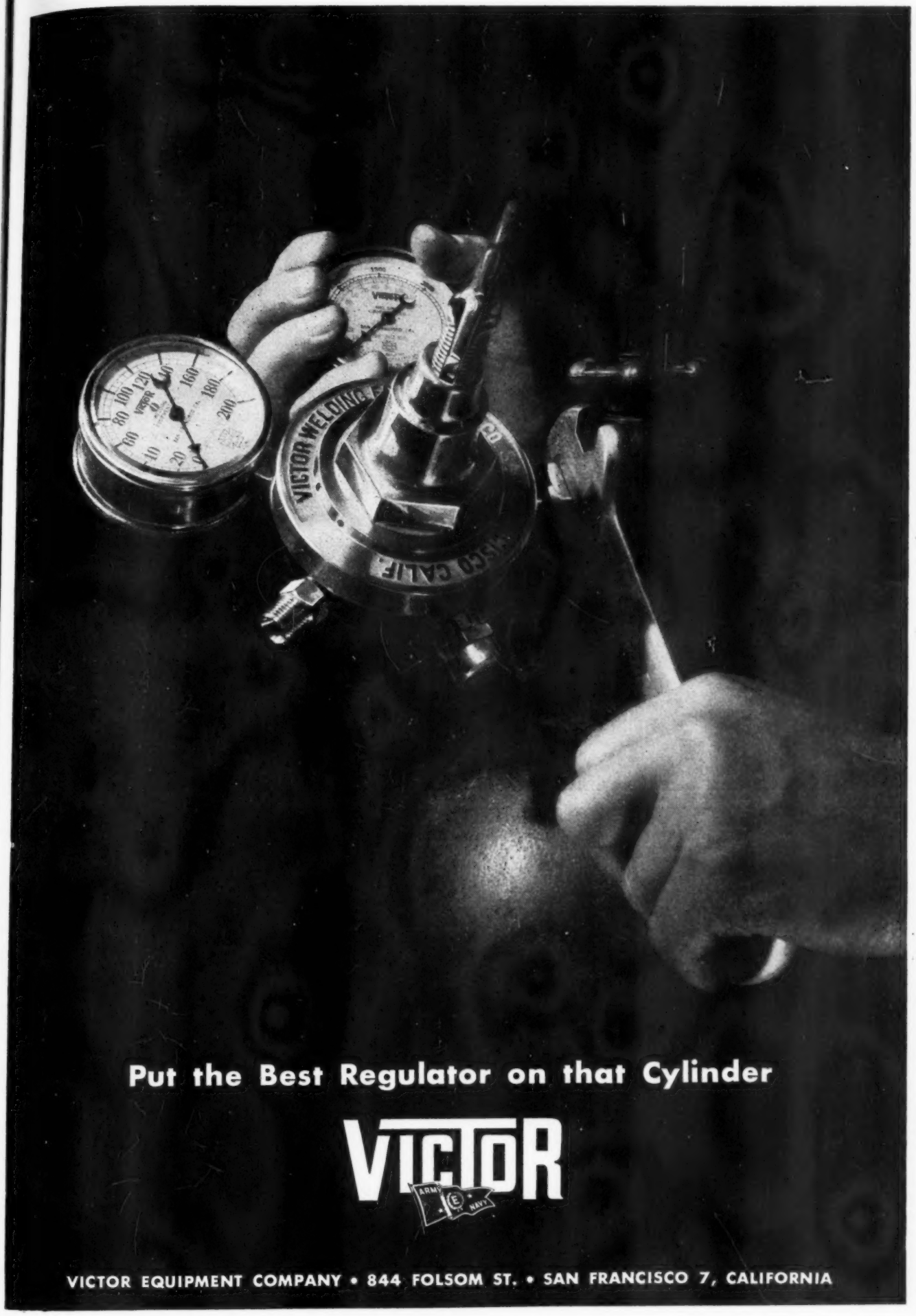
The third step, after adequate yearly appropriations and sufficient numbers of fully qualified Regular Army personnel, should be to promote a more aggressive, far more successful international "intelligence" service by which the U.S.A. can know promptly more intimate details of all foreign armament design development.

Originally our military and naval foreign consulate attachés were supposed to keep our armed forces strictly up to date on foreign inventions and development of war armaments. However, these Regular Army officers were mostly ineffective due to their lack of concept of their prime mission and also because few of them had the highly specialized knowledge by which to recognize and interpret what they did see and ascertain overseas.

Which leads to the common-sense suggestion that we combine all such intelligence efforts into one organization employing highly trained specialists in each field of armament. One of the biggest disgraces of World War II is the fact that none of our peacetime intelligence services fulfilled their missions adequately, some of them even failing miserably during the war.

Whatever training in peacetime is given enlisted men is more than entirely lost, because when we enter war they must first be taught to forget what they learned and then retrained in more modern wartime requirements. No man should be sent to combat until he has been given an extended period of physical conditioning; the time required for such physical conditioning is also sufficient for enlisted men to receive basic training.

What is needed far more is highly specialized peacetime training of wartime officer potential. My suggestion in this regard is that the A.O.A. confine its efforts to a more extensive, much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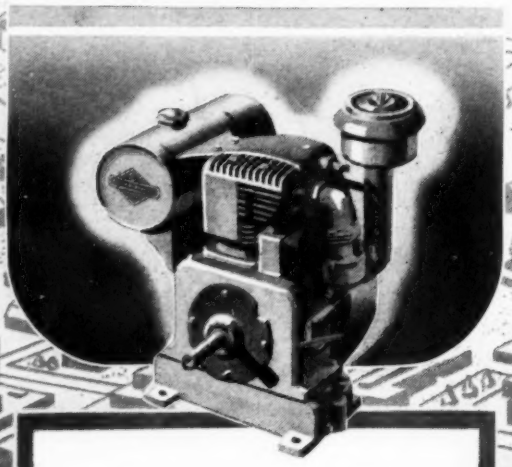

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Communications

more highly specialized training of Reserve officer personnel rather than of enlisted personnel during peacetime. In this lies much of our future strength.

Now to get back to A.O.A. publications. For several years I have noted that all of them seem to regard their mission as one of plaudits for peacetime Regular officer personnel—a sort of mutual admiration society, so it seems. Such procedure leads to retrogression, an effete condition. More censure, criticism, and suggestions are required to maintain our peacetime armament development on a virile, progressive basis. To ignore conditions that need correction would be a national disservice.

In conclusion, let me suggest a change in name and outlook for the Army Ordnance Association. I would change the name to "War Armament Development Association" and include promotion for design improvement for all services—Army, Navy, Air Corps—and not merely for ordnance items.

Charlottesville, Va. E. L. FORD

THE BULLETIN AND LASTING PEACE

THE EDITOR.—I would like to compliment you on your Bulletin No. 62, December 15, 1945. All that you say deserves much praise, particularly the last page, "At Christmastide." You have demonstrated marked ability to write about the subject of lasting peace. I wish that it were possible for the article to receive world-wide publicity.

Denver, Colo. JOHN L. DROBAC

THE EDITOR.—Since the termination of hostilities it has been of greatest interest to me to throw my slight weight for the principles for which we have fought. The last two Army Ordnance Bulletins make me feel quite proud of my membership in the Association.

In Bulletin No. 62 you quoted Dr. Einstein's comment regarding his idea of the proper method of securing a lasting peace. His arguments make sense to both of us. You went further to comment that "Dr. Einstein's advocacy . . . is a bit too impractical . . . to realistic observers."

I question the use of the word "realistic" to describe these observers. However *unrealistic* any proposal for world government may *seem*, is it not your ability to be objectively realistic that makes it your duty to subscribe to such ideas in order to instigate and advance the public's knowledge and understanding of them?

To me it seems that the U. S. is fast losing the initiative in world affairs, and much of this can be blamed on a shortsighted government backed by people who are ignorant or who lack the initiative to prod their government. According to my personal definition, realists are people who accomplish what they set out to do and who never work on a project without considering human values and lasting good.

Boston, Mass. H. F. FRIEDMAN, JR.

THE EDITOR.—Your Bulletin No. 62, dated December 15, 1945, arrived this morning.

My belief is that page 4 of this Bulletin is entirely worthy of the widest possible circulation. May I suggest, therefore, that you consider reprinting this page in quantity and selling copies to your members for distribution to any who may be interested. For such a reprint to carry due weight, its origin should be stated clearly.

I might add that the position taken by Dr. Einstein regarding the atomic bomb seems very sound, in my humble opinion. Who in this country would not feel less secure the minute he is sure the secrets of this weapon have become common property?

Troy, Ohio A. M. HARRELSON

ARMY ORDNANCE

THE JOURNAL OF THE ARMY ORDNANCE ASSOCIATION

Founded 1920

Combined with FIREPOWER, the Ordnanceman's Journal

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It may be timely to emphasize again to readers of ARMY ORDNANCE the unofficial and nongovernmental status of the Army Ordnance Association and its publications. Neither the organization nor any of its magazines has any official tie with the War Department, the Army, or any other element of our Government. Editorial opinions, as well as those of the authors of articles, have no sanction of the fighting services and do not necessarily represent the official views of the Government.

We call attention to this condition at this time because we want it perfectly understood that our future editorial policy will emphasize deficiencies as well as accomplishments in winning World War II. There were marvelous achievements, and there were instances of great leadership. There were many cases of trial and error made in the best of faith with poor results. Similarly, there were tragic mistakes, stupid decisions, and ruthless administrative actions, the results of which have been far reaching.

If we are to learn the lessons of this war, we must study both the successes and the failures. ARMY ORDNANCE proposes throughout the years to examine these impartially and without fear or favor. Some bubbles will be burst while some hidden gems will be brought to light for proper recognition.

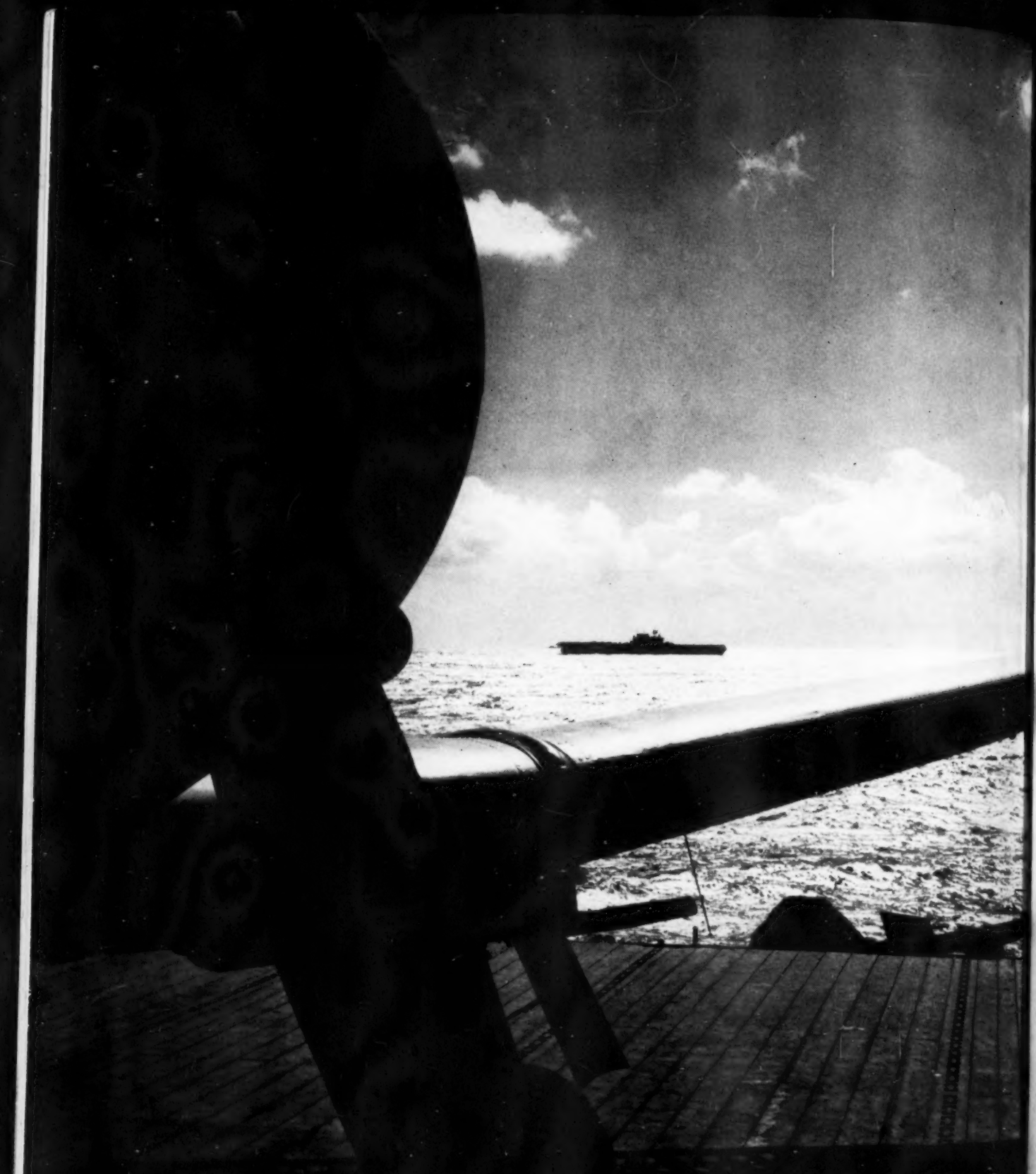
At times the comment as well as the facts may not be to the liking of the powers that be. Objective journalism will be the norm and not the whims and foibles of the individual. The lessons to be learned are far too important to do otherwise.

—*The Editors*

Vol. XXX **MARCH-APRIL, 1946** **No. 155**

Copyright 1946 by the Army Ordnance Association, publisher, 705 Mills Building, Washington 6, D. C. Issued bimonthly. Single copy, 75c (by mail). Subscription rate: continental U.S. and possessions, $4.50 annually, in advance; foreign, $6.00.

Entered as second-class matter, August 14, 1920, at the Post Office at Washington, D. C., under the Act of March 3, 1879. Additional second-class entry at the Post Office at Richmond, Va. Six weeks' notice is required to effect change of address.



"The preservation of peace is dependent upon the ability to make war."

—Vice Adm. Marc A. Mitscher.

Security Looks to Science

Dr. Vannevar Bush Leads the Way to Atomic Research

DURING the war years Dr. Vannevar Bush, president of the Carnegie Institution of Washington, one of the outstanding scientific research organizations in the country, was appointed by the President of the United States as chairman of the National Defense Research Committee, a governmental agency established for the purpose of supplementing the work of the Army and Navy in the development of devices and instrumentalities of war.

Some months later Dr. Bush was made director of the newly established Office of Scientific Research and Development and was charged with the duty of mobilizing the scientific effort of the country, of initiating, in cooperation with the Army and Navy, broad programs of research, of advising the President as to the status of scientific research and development in their relation to defense, and in continuing research on instrumentalities and materials of war and in the field of medicine.

Various other scientific agencies of the Government, as well as research laboratories of educational and industrial organizations throughout the country, worked in close collaboration with the O.S.R.D. from its inception.

Dr. Bush was a central figure in the development of nuclear fission culminating in the utilization of the atomic bomb. His official connection with the project began in June 1940 when the earlier-constituted Uranium Committee was made a subcommittee of the National Defense Research Committee. Decision for an all-out effort in the undertaking was reached after research had progressed satisfactorily and various administrative reorganizations had been made, so that the difficult question of allocating men and materials in a period of national emergency could be answered.

AS a member of the top policy group headed by the President and as chairman of the Military Policy Committee, Dr. Bush shared responsibility for the determination of policy throughout the program, continuing in this work after administration and development had been taken over by the Army in 1943.

President Roosevelt called on Dr. Bush in 1944 for recommendations on ways whereby the lessons learned through O.S.R.D. in time of war might be applied in time of peace "for the improvement of the national health, the creation of new enterprises bringing new jobs, and the betterment of the national standard of living." In response to this request, Dr. Bush prepared a very comprehensive report in 1945, under the title "Science, the Endless Frontier," which drew on studies made by four committees of eminent scientists, engineers, and educators and made specific proposals for the consolidation and utilization of the scientific skill of the Nation for the general good. Legislation embodying and implementing his proposals are now before the Congress.

One of Dr. Bush's most spectacular achievements was the construction of a differential analyzer at the Massachusetts Institute of Technology. The new machine, weighing 100 tons, combines some 2,000 electronic tubes, several thousand relays, about 150 motors, and nearly 200 miles of wire to provide solutions of the differential equations expressing mathematical problems involving as many as 18 variables. Problems in atomic physics, acoustics, ballistics, structures, and electrical machine transients are representative of the tasks for which the analyzer is designed.

Other devices, such as the rapid selector which scans and selects wanted items from microfilm and the justifying typewriter which produces typescript with an even right-hand margin in one operation, have resulted from Dr. Bush's inventive genius.

In July 1945 he wrote speculatively and fancifully of a hypothetical machine called the "memex" which, utilizing components of this sort, would serve as an extension of man's memory, bringing wanted items before him on a viewing screen by means of an associative index and permitting him to review at the touch of a finger all his accumulation of data on a desired subject. On the wisdom with which we bring science to bear against the problems of the coming years, Dr. Bush believes, depends in large measure our future as a nation.

WHILE World War II was in progress, O.S.R.D. scientists under Dr. Bush's direction carried on more than 200 research and development projects for the Ordnance Department of the Army. The technical superiority of such military devices as VT fuzes, as well as a host of weapons, large and small, may be attributed in great measure to this highly fruitful and successful partnership.

ARMY ORDNANCE pays tribute to Dr. Vannevar Bush as representative of that vast aggregation of scientists who came from the laboratories, the classrooms, and the factories to aid the fighting forces in their hour of need. The freshness of their vision fortified by the breadth of their knowledge and experiment harnessed for our country and our allies the unparalleled forces of scientific research. Strangely enough, the cohesion of these groups with the Army and Navy in years past had been all too superficial.

World War II proved beyond doubt that the link between science, industry, and the national defense must be forged of such material that it will grow stronger with the passage of time.

It would be a tragedy of the first order if our scientists were now to return to the precincts of the college and the laboratories and let the fighting forces shift for themselves. If so, we may promptly return to the stereotyped outlook of the G.H.Q. mind. This historic mental outlook has been responsible for the defeat of armies and navies and for the fall of nations.

With science on the one hand and industry on the other, our military and naval forces will be assured of support without which modern war cannot be won. Dr. Bush and his associates have carried the torch high in war. We look to them to carry it even higher—in peace and for peace. Dr. Bush himself has said: "Science has been in the wings; it must be brought to the center of the stage."

TO ALL MEMBERS OF THE GREAT TEAM OF INDUSTRY-ORDNANCE:

¶ The editors of *Army Ordnance* have graciously afforded me this opportunity of saying my official "Good-bye" to all with whom I have worked in the Ordnance effort of World War II. To mention all these people by name is obviously impossible. Even to mention them by group or class of activity would involve a most comprehensive statement.

¶ To my fellow Regular officers of the Department with whom I have been connected these many years, to my fellow officers who have come to Ordnance during the past six years from the Reserves and from the Army of the United States, to all Ordnance enlisted men who upheld so well the highest traditions of the Department, to all the old-line Ordnance civilian employees and to those thousands who have joined the Department during the war, to those men and women of industry working both directly and indirectly for Ordnance, to my fellow officers of the Navy, and to my fellow officers of all branches of the Army—to all of these go my sincere appreciation, admiration, and affection for the support they have given me throughout the period of the war. Never have I found them wanting! Never has the will to win wavered!

¶ Never was the quality of Ordnance questioned by informed combat commanders, and never was an operation delayed due to failure of Ordnance to furnish adequate supplies and equipment at the desired time. Ordnance was truly the Arsenal of Democracy, and it was the work of the Industry-Ordnance team that made possible the equipping of the armies of our allies. Our enemies were literally overwhelmed with firepower as delivered by our weapons and by our bombs in the hands of our incomparable fighting forces. What a glorious page was written by the men and women of American industry, military and civilian!

¶ The thrill which will always come to me as I contemplate the countless instances of unselfish devotion to duty and the positively miraculous performances of development, design, production, maintenance, supply, and training, which were a part of the accomplishments of the individuals of the Industry-Ordnance team, will ever serve to remind me of my great fortune in being connected with such an effort. I often have said that I never could imagine a more selfless effort than that evidenced by these people in their work for their country.

¶ My statutory 4-year term of office is concluded. Other hands will now carry forward during the trying days ahead. After a rest, my first in eight years, I am taking up duties with that splendid industrial concern, the International Harvester Company, as vice-president where, in the words of its president and that great industrial leader, Mr. Fowler McCormick, my responsibilities will be "to coordinate the many aspects of Harvester's large program of new plant construction, reconversion, and equipment, and to assist all those who are involved in the task."

¶ Ordnance has successfully supplied the Army in seven wars and has just emerged from World War II as the great giant of the logistics art. It will continue on down the ages as a tower of strength and safety to our Nation. Surely this country, which has just completed the second great war within a single generation, will not permit another state of unpreparedness such as followed World War I. Ordnance should go forward with a strong program of research and development, with adequate funds to insure that our weapons will always be superior to those of any one so that, should war unhappily be thrust upon us, we will be prepared to become again the master of our enemies.

¶ I am very hopeful that the great mass of men and women of industry will continue their interest in Ordnance—as I most certainly will. Let us all continue to support our own civilian Army Ordnance Association as an expression of our will for industrial preparedness against war—a certain guarantee of peace.

¶ And now, if I may be permitted a personal note, I want to take this opportunity of thanking each and every one of the great Industry-Ordnance team for that support during the war which made my success as Chief of Ordnance possible. To all I send my best wishes for the success of America and to each individual a devout "God bless you."

LEVIN H. CAMPBELL, JR.
Lieut. Gen., Chief of Ordnance, U. S. Army.

Action in the Pacific

U. S. Navy

Task Force 58 Took A Deadly Toll In the "Marianas Turkey Shoot"

Vice Adm. Marc A. Mitscher

THE war in the Pacific was divided into four phases. First there was the purely defensive war, which was fought immediately after Pearl Harbor when we and our allies were attempting to slow the Japanese thrust to the South and Southwest Pacific.

Then came the period of the defensive-offensive war, when our forces realized that the Japanese thrust had to be checked before it severed the Australian lifeline. This period ended with the Battle of the Coral Sea, which successfully checked the Jap threat to the southward, and the Battle of Midway, which was a decisive defeat for Japan and the first suffered in the history of her navy. It succeeded in completely frustrating her invasion attempt. Never again was her offensive force to prove a real threat to us.

With the defeat at Midway, Japan was now on the defensive, and the initiative was ours—we entered into the offensive-defensive stage of the war and inaugurated that phase by our landings in the Solomons. Upon securing this strategic base we entered upon our offensive stage and commenced our 2-pronged thrust from Australia under General MacArthur and from Hawaii under Admiral Nimitz.

With the offensive under way, our carrier task forces became the spearhead of the thrust toward the Empire, while the tip of this spear was composed of our submarine force and patrol planes harassing enemy lines of communication. Our integrated team of Army, Navy, Air Forces, Marine Corps, and Coast Guard began its offensive drive to the north.

The general pattern for this offensive was as follows: Once the objective was decided upon, our fast carrier task forces proceeded to soften up the target for the amphibious assault by bombing and strafing strikes aimed at destroying the enemy's air power and ground installations and at the same time photographing the terrain for the amphibious forces. During this process, should the Jap fleet endeavor to interfere with the operation, then it was the job of the fast carrier task forces offensively to resist this opposition by destroying the Jap fleet.

Once the target was prepared for the invasion, the carrier task forces supported the landings by covering the approach of the landing craft, neutralizing enemy air on the other enemy bases, and attacking such targets as presented obstacles to the assault forces. Once the objective was taken by the ground troops, the task forces moved on to the next target.

As our forces proceeded northward through the island empire of the mandated islands, it became apparent that we could by-pass many of the enemy's positions because our control of the sea and our efficient submarine warfare left the enemy with no lines of communications with which to support these strongholds. Consequently we chose enemy positions of strategic advantage to us and by-passed the others, leaving their garrisons to ponder over the fate of an island stronghold unsupported by sea communications.

This, then, was the over-all pattern of the march to victory in the Pacific, but to better illustrate it I shall outline in detail the operation of Task Force 58 in support of the capture of the Marianas.

Task Force 58, which was assembled in the Marshalls, sortied on June 6th and headed for the target area which was the island of Saipan. On June 11th, fighter sweeps consisting of 221 Hellcats were launched at about noon, approximately 250 miles southeast of Saipan. We varied our usual dawn attack as we knew by this time that the unexpected would confuse the Japs.

As a result of these sweeps a total of 120 enemy planes were definitely destroyed and another 27 probably destroyed or damaged. Eighty-one of these enemy planes destroyed were shot down over the target, and ten were shot down around the force. Our combat losses were eleven fighter planes and eight pilots.

ON the morning of June 12th, strikes consisting of bombers, fighters, and torpedo planes were launched at dawn against the same targets as the fighter sweeps to destroy installations and any remaining planes. These strikes destroyed the planes the Japs had left, thus accomplishing our first objective—neutralization of enemy air in the target area. However, this was but the first step in our offensive. Knowing the Japs, we could expect air reënforcements from any number of their island bases, including the Philippines, to be flown in at any time. Consequently, to forestall this, or reduce it to a minimum, some of these bases had to be attacked.

It was decided to strike the logical

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staging points at Iwo Jima and Chichi Jima with carrier-based planes while Army Liberators were to harass the fields on Palau and Yap to the southward, thus preventing, to as great a degree as possible, the staging of air reënforcements from the Empire to those points.

As for the Jap fleet, if it proposed to fight there were several courses of action open to it, all of which had to be considered by us should it attempt to interfere with our landing operation. The conclusion was reached that the Japanese fleet could not seriously hinder the occupation of the Marianas as long as Task Force 58 could engage the major portion of it.

With this in mind the task force moved to the westward of the Marianas and formed for battle. The carrier task groups were disposed to the eastward of the battle line. I should like to point out here that though this position of the task force was a logical one there were a few distinct disadvantages. First, we could not move too far to the westward in search of the Jap fleet, for they could then outflank us to the east and race to the aid of the beleaguered garrison on Saipan. As much as we wished to engage the enemy fleet, our primary mission was the protection of the landing operation on Saipan.

Secondly, we were interposed between any Jap fleet advance and the islands of Guam and Rota, which were held by the Japs and which contained airfields at which enemy carrier-based planes could land. This is significant in that the Japs did exactly that when their air attack materialized. Thus, in effect, their planes could be launched farther from an objective than ours, for they had practically a one-way trip. How we offset this will be shown later.

ON June 18th, information was received that one of our submarines had sighted an enemy surface force on a course and speed such that at dawn, on June 18th, it could be 660 miles southwest of Saipan. We could not hope to strike the enemy on the morning of the 18th, but if we steamed directly toward him, a position could be reached such that we could strike him in the late afternoon.

This course of action proved unfeasible due to the tactical disposition of our task groups at this time, two of which were returning from neutralizing raids on the Bonins, would not rendezvous until noon, and had to be fueled. Therefore it was decided to rendezvous the task groups before heading west to intercept the enemy. It further developed that, after our rendezvous and providing the Japs maintained course and speed, we could close for a night surface action. After careful consideration, this was discarded.

As soon as the rendezvous was effected, a course was set in a southwesterly direction and searches launched at 1330 with negative results. After dark the course was reversed. Searches launched at 0200 and 0530 produced negative results and led to the conclusion that the Japs had decided to maintain their distance and had not tried to pass around us to the southward.

"It has been said of the carrier that the atomic bomb has made it obsolescent. Perhaps this may be so in time, but we know that the carrier is a proven weapon."

In the early morning of June 19th, the day of the "Marianas Turkey Shoot," unidentified aircraft appeared from the southwest heading toward the Marianas. These were carrier aircraft from the Jap fleet. Our fighters reported planes taking off from Guam and Rota and sent out the "Hey, Rube" requesting more fighters at the same time. These were dispatched immediately.

By now it was apparent that our force was soon to be under attack by both land- and carrier-based aircraft, and that efforts should be made to destroy as many land-based aircraft as possible before the carrier planes arrived. At about 0830 a large group of bogies (enemy aircraft) was discovered approaching Guam from the southwest. Our fighters over Guam were reënforced, and this raid was intercepted with many enemy planes destroyed. By 0930 a number of planes had been destroyed, but planes were still taking off from Guam, and planes were still on the field.

Bogies began to appear in all sectors, and at 0959 large groups were detected about 130 miles to the westward, indicating the beginning of the carrier-plane attacks. We launched additional fighters, bombers, and torpedo planes, which were told to rendezvous to the eastward so that decks could be kept clear to reservice and rearm fighters needed to repell the forthcoming attacks.

Attacks were continuous now and varied from a few up to seventy planes. However, our superb fighters intercepted most of these and shot them down. Very few got into the force. The sky was completely clear, and wherever we looked we could see nothing but ice trails of our planes attacking the enemy—a glorious sight to us. Their efforts resulted in two near misses, one on the BUNKER HILL and one on the WASP with superficial damage. The attacks continued in force until about 1500 at which time approximately 350 planes had been shot down.

AT about the same time torpedo planes and bombers which were already in the air were ordered to bomb the fields on Guam and Rota which the Jap carrier planes were using. This strike was carried out with highly satisfactory results. Enemy planes were still landing on these fields, and fighters were sent to destroy as many as possible. Enemy planes from their carriers continued to be shot down until 1900 when our planes were recovered, and the task force headed on a westerly course. This ended the "turkey shoot." We had knocked out 402 enemy planes.

During the day information was received that one of our submarines had torpedoed a carrier of the SHOKAKU class southwest of the task force. Leaving one task group to cover Guam and Rota and to protect the landing on Saipan, the remaining groups set course to intercept the enemy. At daylight on the 20th, a morning search was launched from southwest and northwest, but the results were negative. It was believed that the damaged ZUIKAKU was retiring to the northwest; consequently at 1200 the battle-force course was set to the northwest and a search sent out for the enemy force. We were hoping that the enemy, in covering the retirement of her disabled carrier, might remain within striking distance of our carriers and thus provide us with the opportunity to launch one heavy strike against the enemy fleet.

About 1550, one of our regular afternoon search planes reported sighting the Japanese fleet in three different groups. At 1553 the commander of Task Force 58 informed the commander of the Fifth Fleet that the carriers expected to launch every plane available and would probably have to recover them at night.

This decision was made on the hope

that carrier aircraft could so damage and slow the Japanese fleet that the battleships and cruisers could close during the night and sink all ships which could be reached. The plan required the recovery of planes at night and a fatiguingly long flight, particularly after a full day of fighting the day before.

At 1555 the task groups were instructed to launch a deckload and to prepare a second deckload. At 1624 planes were launched, and simultaneously information was received placing the closest enemy group sixty miles farther than was expected. This meant a strike at 325 miles. In spite of this range it was decided, in order to slow some units of the enemy fleet, to let the first attack group proceed and hold the second.

Since the enemy had been alerted by our search planes, it was imperative to damage part of his fleet that night or else the opportunity to bring even a portion of his fleet to decisive action would be lost. At 1844 the attack was delivered. The damage inflicted was estimated as follows: *Sunk*—2 light carriers, 2 destroyers, 1 tanker; *Possibly sunk*—1 carrier, 1 tanker, 1 destroyer; *Damaged*—14 vessels of various types. Twenty-six enemy planes were shot down, last of an estimated 450 that they could carry. Very few planes were seen on deck.

At 2045 our planes began to return and to land aboard. These landings continued until about 2300, with planes landing on whatever carrier was available. Planes landed in the water, and there were deck crashes by pilots who were fatigued. We were burning searchlights with abandon. The destroyers did a splendid job recovering pilots and crewmen from the water, though they were kept very busy. Our losses, killed or missing, from this action were 16 pilots, 22 aircrewmen, 2 deck officers, and 4 ship's enlisted men.

During the night, patrol-plane searches reported the enemy headed generally northwest at varying speeds. At 0200 the task force launched search torpedo planes with instructions to shadow the enemy. This search reported the enemy about 360 miles away, speed 20 knots at 0700. This was outside the strike range of our carrier-based planes. Previous plans for sending the battle line in pursuit were abandoned. We had hit the enemy hard the one time he was in range, but he was only damaged, not destroyed. He had, however, been driven from the Marianas. The final success in the capture of the Marianas is now history, which also now reflects the subsequent victories in the battles of the Philippine Sea.

While I was in command of the Army, Navy, and Marine Corps air components in the Solomons, we were subjected to nightly raids by high-level Japanese bombers which approached at 26,000 to 28,000 feet. Our main antiaircraft batteries consisted of 90-mm. guns whose pattern of bursts was beautiful but which was 2,000 to 4,000 feet below the enemy aircraft due to fuze limitations.

As a consequence we were unable to defend ourselves against them by gunfire, and our only defense was aircraft. I believe it quite significant that in my entire Pacific experience I never saw a horizontal bomber shot down by gunfire, although I know it can be done.

AS to dive bombers, and I include kamikaze planes as dive bombers, of the 10 per cent which escaped our aircraft and proceeded to the attack of the task force, 2 per cent were direct hits on ships, 90 per cent were near misses—*i.e.*, inside the formation—and 8 per cent were shot down by ships' antiaircraft outside the screen of the formation. These are not, in my opinion, figures which speak very well of our ordnance equipment as far as the antiaircraft gun is concerned. The airplane has often been referred to as a gun which carries its projectile to the maximum range of the airplane; but an airplane is not a gun, it has a brain—a brain which must be outwitted by a projectile which does not have a brain.

The kamikaze dive bomber is an example of this. Unless by happenstance a direct 5-inch hit were made on this type attack, the pilot, by maneuvering his controls, kept on until he arrived at the target. If 20- or 40-mm. set him on fire he still kept on and, even though badly damaged, if his control surfaces were not shot away, he proceeded to arrive at the target. Many times the pilot was dead but the plane's momentum carried it along the predetermined flight path until it hit.

To counter this we need a gun with a brain as well as with a velocity that reduces the time of flight of the projectile or one that fires a missile which can be controlled until it arrives at its ultimate target. The range of this weapon must be such that it can intercept the horizontal bomber before it releases its bomb—destruction of the aircraft after bomb release is of secondary importance.

As to the dive bomber, the gun's brain must be such as to superimpose its will upon the projectile fired at the target. The answer may lie in high-velocity rockets, jet-propelled missiles, controlled missiles, or the use of power yet to be discovered.

It has been said of the carrier that the atomic bomb has made it obsolescent. Perhaps this may be so in time, but we know that the carrier is a proven weapon—its record speaks for itself. There have been many interesting "Buck Rogers" mechanisms proposed for use in the conduct of war, yet they are not proven weapons, and some are even in the drawing stage. Until such time as research, development, and actual experience prove the efficacy of new weapons, let us continue the development of those which we have.

With the advent of the submarine, and later of the airplane, various individuals blandly informed us that surface ships were doomed. Such has not been the case. New weapons have always appeared with great fanfare as to their possibilities, but when the weapon has been studied there has always been a limitation in its use and a countermeasure which reduces its original efficacy. Undoubtedly countermeasures will be found for the atomic bomb.

The victory is now ours, but with its advent came also the responsibilities inherent to the most powerful nation on the face of the earth. The preservation of the peace is as vital a task as was its winning, and we must play a part commensurate with our position at the surrender of Japan. It is paradoxical that the preservation of peace is dependent upon the ability to make war, but nevertheless this is a fact.

We as a nation must never again be unprepared—twice this has happened to us and twice our allies have given us time to get ready. However the element of time may never be available again, for the war of the future will be prosecuted in such a manner that we will not have that advantage.

The Nation in Arms

Peoples, Not Armies and Navies, Fight Wars

Gen. Dwight D. Eisenhower

IF there is anything that warms the heart of a soldier, it is progress in any worth-while project. My mind goes back fifteen years when I was rather intimately associated with the Army Industrial College. At that time if the college had a rather formal or important meeting involving its faculty and its student body, we were extremely fortunate if we could interest one special service chief sufficiently to come and convey to us some of his thoughts on the work of that college and the subsequent work of the graduates.

I thought at that time that I had some vision with respect to the mission of this school and the tremendous value that would flow to the United States from the work of its graduates. But had I then told the Industrial College that in 1946 two civilian secretaries of the Army and Navy and the military heads respectively of the Army and Navy would all simultaneously attend one of your convocations, I would have received nothing but a long and earnest Bronx cheer.

The presence of these people is a practical demonstration that all of us have waked up to a livelier realization of the fact that nations and not merely armies and navies fight wars. Since the days of the French Revolution we have given lip service to that concept, but it was exceedingly difficult to get some bold operational man who fancied himself as a future commander to give his attention to the business of finding out how to manufacture a tractor and how to do it without damaging the economy of the country and, more particularly, without damaging the procurement possibilities of other services.

We have come a long way. And here, parenthetically, I should like to remark that my own interest in this college will never flag. I expect to demand from the commandant at intervals a report on the quality of the work being done by the students, because I will use such influence as I have to see that from the Army's side only men of superior intelligence and fine promise become students here, including young men who can show some of us oldsters how we should go. They are the type of people that must comprise the student body.

Inevitably this is one of the most important educational years or periods. But it is not so much of your educational tour that I think as of how you are going to use that education when you go out, because you in a very real sense must integrate the Army and Navy to the industry and economy of the country. There must be no limit to the scope of your interest. You must use imagination. You must not be tied down to tradition, routine, or ritual. Any one who tries to prevent you from reaching out almost into the realm of the fantastic is wrong.

You men cannot be satisfied that because we have had *X* number of procurement services within the Army that number is always going to be correct. You cannot be satisfied with anything. You cannot take anything for granted. Although we did win this war, the next war, if it unhappily comes upon us, may be more difficult to win. You must look into that field without any limit upon your sights even as you go ahead in your day-by-day work of meeting the objectives of the moment.

ONE other thing: Inescapably your work must be in the nature of cooperation. Within the Army there are several coequal services. As between the Army and Navy there are also coequal organizations. No matter what the Congress may decide as to the higher organizational features of the Army and Navy, let no man kid himself that in some detailed organization is to be found the secret of successful operation. It is in the faith and the confidence that we can develop among ourselves that that secret is found.

In coöperation I think I may claim to have some experience, because necessarily the command I held during the war had to depend upon the coöperation of independent bodies. You must approach that always with the knowledge in your mind that coöperation is a 2-way street. You must give as well as receive, which means an open mind, objectivity, and a sense of humor.

For my part, in any feature of the Army's operation, and I have particular reference to the operations which you gentlemen have to carry on, any indication of a lack of spirit of cooperation with all others, with the Navy or with civilians, in any place where coöperation is called for, will be met with action on my part that I am quite sure will be effective. I say that only because I have lived that doctrine for so long that I am sure that in it is found the key to success in any operation.

I cannot congratulate you men too highly upon the opportunities that are now open to you. There is no limit to your studies. You have an unusual opportunity to understand and appreciate each other, to understand and appreciate your compatriots in the other fighting services, and to become intimately acquainted with the civil life of this Nation, always remembering that it is the nation that fights a war.

General Eisenhower is Chief of Staff of the United States Army. These remarks are based on an address given at the convocation of the Army Industrial College, Washington, D. C.

These remarks of General Eisenhower and those of Admiral Nimitz and Under Secretary of War Royall on the following pages were made at the convocation of the Industrial Mobilization Course of the Army Industrial College in Washington, D. C. This course began in January and will conclude in June.

As General Eisenhower so aptly points out, the increasing importance of the college is demonstrated by the fact that military, naval, and civilian leaders of the Government were present to inaugurate the course.

Brig. Gen. Donald Armstrong, commandant of the Army Industrial College, gave an interesting and detailed account of this institution in his article, "School for Security," published in the November-December 1945 issue of ARMY ORDNANCE.—EDITOR.

Industry and the Navy

The Civilian Power behind Our Sea Power

Fleet Adm. Chester W. Nimitz

SINCE its inception, the Army Industrial College has been a joint undertaking of the fighting services, and few of our activities have proved more valuable. The graduates of this college have exerted noteworthy influence on naval procurement and planning and have helped industry make its great contributions.

If there has been any mistake made in the conduct of this institution, I would say it occurred in discontinuing the college during the years of the war. I had a similar experience when I came to Washington in 1938 and began to examine the war plans of the Bureau of Personnel.

I discovered that it was planned that the Naval War College, then under the Bureau of Personnel, the Postgraduate School at Annapolis, and many other schools were to be closed at the outbreak of war. That was obviously based on the idea that any war we might have would be of very short duration. But we changed the plans, and I think it was the correct thing to do. I hope that there will be no plan to close the Industrial College during any future emergencies.

In the war just ended the road from initial disaster to victory was long and bitterly fought. The first enemy blow in the Pacific sent us and our allies staggering. We lost base after base—Hong Kong, Singapore, Manila, the Dutch East Indies.

We recovered our strength and multiplied it many times within a period we would have considered impossible five short years ago. In the very dark days at the beginning of the Pacific war, when our small forces were outnumbered and outequipped, a great moral strength enabled us to fight a delaying action which afforded the precious time needed to produce for our recovery.

And it was faith that our Nation's industry would turn out the goods that helped immeasurably to sustain this moral strength in our fighting services. With most heartening determination and ability the industrial machinery to get what was needed to the place it was needed, on time, and in sufficient quantity, was set in motion at every level of the country's industrial and military life. Militarily speaking, then, the sacrifices of our fighting men in all the delaying actions were justified.

But even a valiant delaying action, fought over a period of months, may not afford us sufficient time to arm ourselves fully in the event of another war. The demands will probably be immediate. To that end it is imperative that the country's fighting services, the nonmilitary governmental agencies, the industrial elements, and the people in general, work and plan more closely together than ever before, maintaining an active interest in each other's problems, so that their primary collective concern—our national security—may be assured.

The graduates of the Army Industrial College will hold key positions in bringing this about. The combined application of your interest, knowledge, and skills will make the difference between a satisfactory military materials potential and an excellent one. We must have an excellent one. Modern war is total. No nation can wage successful war which fails to utilize its industrial capacity to the fullest extent. It is not enough to have a great industrial plant. That plant must be mobilized, supplied, and made an integral part of the war machine.

I was frequently made sharply aware of the vital necessity for adequate material support in this past "war of supply." Every phase of our operational planning in the long reaches of the Pacific was tempered in one way or another by the element of logistic support. Strategic and tactical plans to defeat the enemy were on every occasion dependent for their success upon the availability of supplies and equipment. This statement appears obvious.

But in the case of long-range and large-scale strategic and tactical plans, concern over the matter went far deeper than the number of days' supply on hand in our supply facilities in the immediate areas of operation. Such plans went into the ability of United States industry to meet the constantly growing material requirements of the fleets and armies.

> **"Of the basic elements which comprise the operating forces of our Navy—ships, planes, bases, supplies, and personnel—the first four are the direct result of industrial effort."**

THE word "industrial" in the title of the Army Industrial College has many implications and meanings. It is impossible to explore them in detail here. But, taken collectively, it means the living heart of our entire system of material livelihood. As applied to the Navy, it is a fundamental factor of the Navy's existence. Of the basic elements which comprise the operating forces of our Navy—ships, planes, bases, supplies, and personnel—the first four are the direct result of industrial effort. The importance of maintaining our industrial production potential is paramount; in fact, it is absolute.

Grand strategy and joint action in military matters are the province of the Army and Navy Staff College. The field embraced by the Industrial College in its studies of the industrial and economic structure for war is at the same level of importance. Its plans must support the concepts evolved by the Staff College. Its conclusions will have a controlling effect on strategy. Obviously the two institutions should work in closest harmony. Strategic and industrial mobilization plans are distinct but must be closely integrated.

The Industrial College can perform a tremendous service for our country at this time. Its students are here, not so much to learn what has been done in the past as to devise new and dynamic plans for the future. It is only from a group like this that such plans can come.

Admiral Nimitz is Chief of Operations, U. S. Navy. These remarks are based on an address given at the convocation of the Army Industrial College, Washington, D. C.

Alertness Means Security

Industrial Preparedness Is the Price of Peace

Kenneth C. Royall

THE 1946 convocation of the Army Industrial College may well mark the beginning of a new epoch in the history of our ability to harness our resources of every kind through industrial mobilization for the greater security of the Nation.

We are not embarking upon entirely unfamiliar seas, but we are embarking upon inadequately charted ones. The depths of many of our reefs and shoals encountered in part on our last voyage still remain to be completely sounded. We are better equipped than we were; we have many able pilots to guide us. We can still be well and quickly provisioned for the kind of journey we knew, but we have no assurance that our next journey will be of that kind.

Thoughtful analysis and evaluation of experience, both military and civilian, in industrial mobilization and demobilization and in procurement and production in World War II are now the order of the day. What is done here in the next six months will be vital in determining the effectiveness of many of the industrial phases of our readiness in defense.

The Army Industrial College, being a joint Army and Navy school of postgraduate standards, is expected to provide the factors required to materialize our national mobilization needs, not alone for the immediate future but for long-range programs as well.

WE know now that, despite our enormous resources in materials and facilities, we were at times during the last war strained to meet the demands of our forces overseas. We also know that every industrial-mobilization requirement is inextricably woven into our civilian economy. Our whole national resources, natural and creative, are involved.

We must learn how better to utilize what we have—how to pioneer in new methods and use our experience to plan so we may accomplish more and in a shorter time if the necessity ever should arise again. No matter what the clamor or what may be our desires to put speedily behind us the pressure required to produce for the crisis just passed, the Nation looks to the armed forces for its assurance that never again must we depend upon allies to hold an enemy until we can mobilize industrially.

History proves that as a nation we must be alert. That alertness, in so far as it concerns industrial mobilization, begins with how thoroughly and quickly we forge strength into our economic armor and provide suggestions for a defense against any possible economic weakness.

Beyond a complete grasp of the factors concerning our natural resources and raw materials, particularly those which were critical and strategically essential—whether domestically available or obtainable from foreign sources—we must, for operational planning, know the industrial skills, the physical fitness, and the geographical distribution of our man power by age groups.

Facilities and services, transportation and communication, and all essentials of the domestic economy, are the potentials about which information must be harnessed by the laboratory which is this Army Industrial College.

The Planning Division of the Office of the Under Secretary of War will require all this information for the Army and more. The Army and Navy Munitions Board and the General Staff will make use of it. Most of the problems which form the basis of a need for better information are barely removed from yesterday. The war is just over; if we do not procrastinate and leave the solution of these problems to the dim and hazy future, we will gain the advantage of having the helpful assistance of those who used, as well as those who produced, our industrial output.

I want to stress the close liaison between the Army and the Navy Departments. While the Army Industrial College is supervised by my office, our interests in it are joint, and there are many other responsibilities for industrial mobilization which we share with the Navy. Together we are the Army and Navy Munitions Board, and I would like to say a brief word about that institution inasmuch as it is so closely linked with the work of the Industrial College.

> **"The deterrent to attack is not for us alone to know that we are ready but for every one else in the world to know it, too."**

Organized in October 1922, it had never completely gone out of existence, although, with the major reorganization of the War Department in March 1942, a great many of its functions were distributed to new agencies. During hostilities the War and Navy Departments jointly handled certain matters of priorities and clearances on strategic materials through this board. It acted as a clearing house for export control for shipments to neutral countries adjoining theaters of operation.

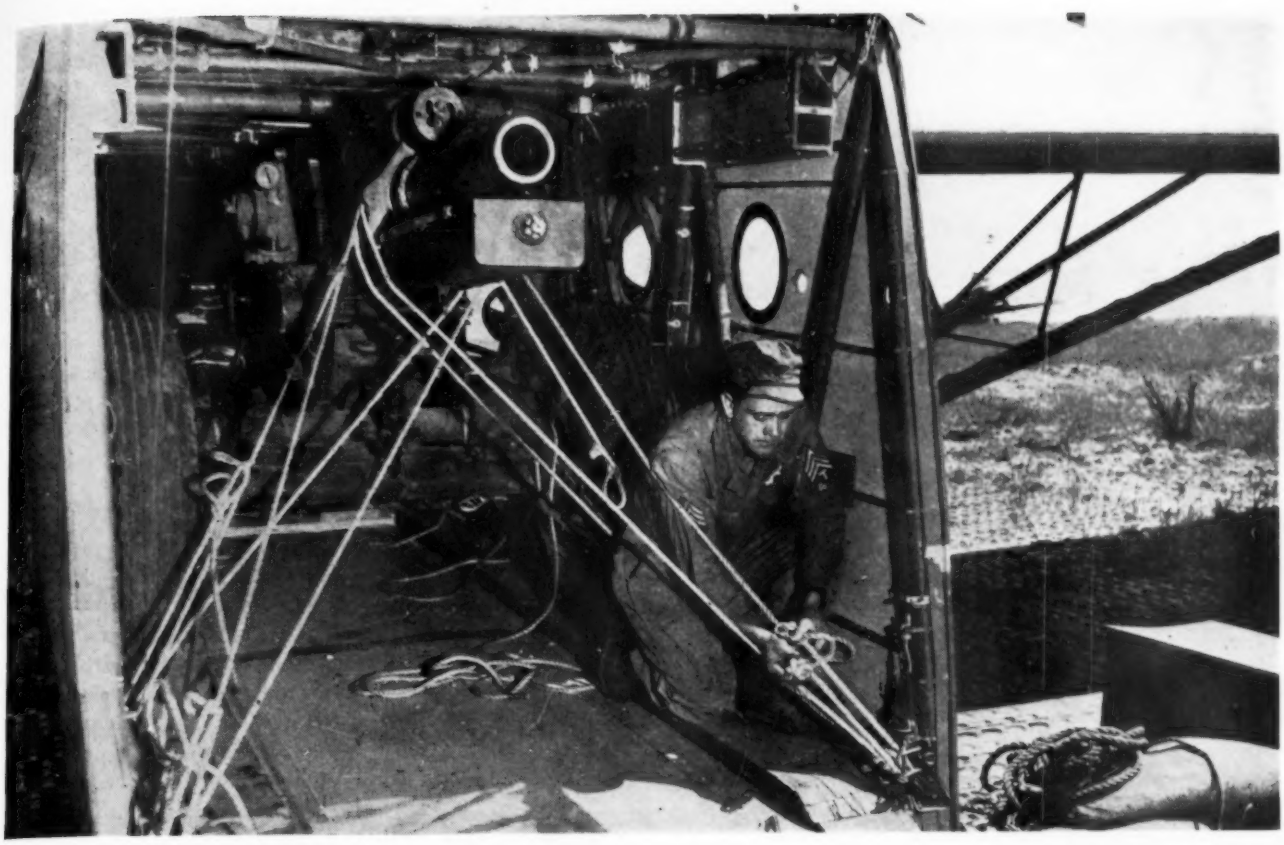
From August 1945 the President of the United States in his capacity as Commander in Chief directed that the functions of the Army and Navy Munitions Board be revitalized and extended

We must not ignore the virtual certainty that in any future emergency we are unlikely to have the same amount of time we had in either of the two World Wars. We must not overlook the fact that what we learned ourselves about producing with speed and in volume we have also taught to others.

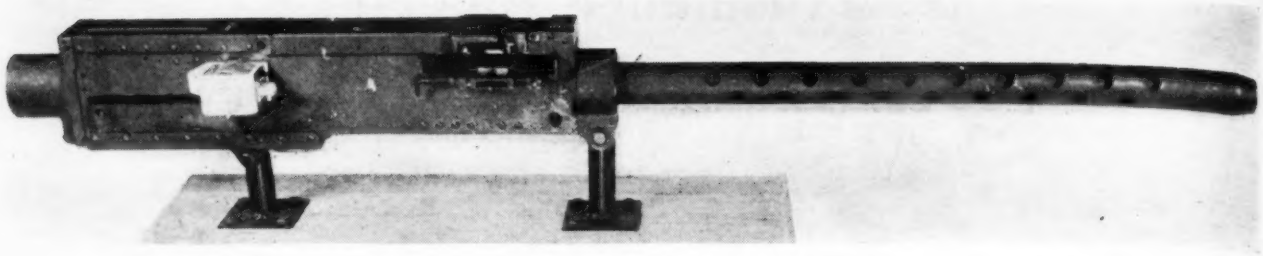
Our ability to survive an aggressor's attack will depend upon the suddenness with which we can strike back. The threat of potential power will not be enough. The deterrent to attack is not for us alone to know we are ready but for every one else in the world to know it, too. This college must demonstrate to America and the world our ability to act, and act promptly, in the next war emergency.

Mr. Royall is the Under Secretary of War. These remarks are based on an address given at the convocation of the Army Industrial College, Washington, D. C.

New Ordnance Matériel



The 105-mm. M2A1 howitzer has been modified to fit into a standard glider, as shown above, thus giving air-borne troops the advantage of its long range. Ordnancemen trimmed carriage width 5 inches, reduced weight 400 pounds. Main armament of the new battle-tested 33-ton British Comet tank, below, is a new 77-mm. gun. Comet's speed is 32 miles an hour. (British photo.)



A New Aircraft Machine Gun

The M3 Weapon Increases Aërial Firepower Fifty Per Cent

Col. René R. Studler

AN immediate increase of fifty per cent in the firepower of our combat aircraft is provided by the Army's new caliber .50 aircraft machine gun M3. While the new gun is of practically the same size and weight as the older M2, it fires 1,200 rounds a minute—half again as fast. This means that a fighter plane mounting six of the new guns will have firepower equivalent to nine of the guns presently in use. The B-25 airplane, armed with its 14 forward firing guns, if equipped with the M3 would be able to hurl 280 caliber .50 slugs at the enemy during each second of firing. The proved destructive ability of caliber .50 ammunition when combined with the increased hitting power of the new gun gives new effectiveness to America's combat airplanes.

The gun presently in use has itself an enviable record of reliability and performance. Gen. H. H. Arnold, commanding general, Army Air Forces, has said of the M2 gun: "This weapon has enabled the Army Air Forces, the United States Navy, and the Marine Corps to show a definite superiority in aircraft gun power throughout the global war."

It became apparent early in 1937 that, as the speed of air combat increased, a corresponding increase in the rate of fire of aircraft weapons would be required. At that time the interest of the Army Air Forces in a higher rate of fire was expressed by General Arnold during a conference at Aberdeen Proving Ground, Md. As a result, in the early years of the war the rate of fire of the M2 gun was increased from 600 to 800 rounds a minute. This was a start in the right direction, but only the first step. The Ordnance Department continued with the development of what was to be a gun of "super" speed. The M3 is that gun. Its performance is far superior to that of any gun of comparable caliber or weight in existence. Its use will broaden still further the margin of superiority of our aircraft armament.

Characteristic	*M2*	*M3*
Rate of fire	750-850 r.p.m.	1150-1250 r.p.m.
Belt-lift capacity	17 lbs.	35 lbs.
Weight	62 lbs.	63½ lbs.
Length	56¼ in.	57¼ in.

Comparative data on M2 and M3 guns.

The new aircraft gun was developed by the combined efforts of the Ordnance Department and several commercial facilities operating as a team and is typical of the superior weapons which have resulted from such coöperative effort.

WHILE the problem of increasing the cyclic rate of a machine gun may be easily overcome by the use of several well-known devices, it must be remembered that the impact stresses in a mechanism will increase as the square of the velocity of the moving parts. Thus, the problem in designing the M3 gun, with its fifty per cent higher cyclic rate, was to design each part to take more than twice the stresses of the older gun without increasing the size or weight.

The outstanding special components of the new gun, as compared with the M2, are as follows:

1. Lightened bolt with improved metallurgy.

2. Extractor with reversible ejector which eliminates the necessity of forcing the ejector between the rounds of the ammunition belt. This greatly improves operation of the gun in cramped aircraft installations.

3. Pneumatic barrel buffer which gives greater smoothness of operation and is not affected by temperature extremes. This buffer uses no oil and requires no special maintenance.

4. Redesigned accelerator which makes more effective use of the excess energy of the barrel and barrel extension to speed up the recoil of the bolt, thus increasing the rate of fire.

5. Belleville spring bolt buffer which utilizes cupped steel washers instead of the fiber disks of the M2 gun. This buffer returns more energy to the bolt and speeds its counterrecoil, thus increasing the rate of fire.

6. The breech lock depressors are rigidly mounted to the side plates of the gun. This prevents movement of the buffer body and greatly improves the stability of the gun components.

7. A special back plate which clamps around the receiver and prevents spreading of the side plates and consequent tearing out of the back plate.

8. Breech lock cam with a curved cam surface which gives smoother operation of the breech lock and reduces battering of the gun components.

9. Special top cover which incorporates a feed pawl shaped to fit the cartridge and link, and a strengthened belt-feed lever. This cover assembly gives increased belt-lift capacity.

10. Split belt-holding pawl which has been incorporated into all caliber .50 aircraft machine guns. This assembly improves the feeding of ammunition to the gun in cramped installations.

Colonel Studler is chief, Small Arms Development Division, Ordnance Research and Development Service.

Press Assoc.

New Aërial Weapons

Secret Aircraft and Equipment Shown for the First Time at Wright Field

Col. Philip Schwartz

WHILE the recent war was being fought the nature of many of the weapons used was a secret, and the general public was not permitted to learn of their existence or make-up. This secrecy gave rise to many statements like "had the war lasted much longer our enemies might have beaten us" because of their supposedly improved aircraft, such as jet planes, or their new and more effective armament, such as buzz bombs.

During October 1945, Wright Field, Dayton, Ohio, commanded by Maj. Gen. Hugh J. Knerr, had a 10-day exhibit of many Air Force weapons which previously had been in the secret category. This exhibit was arranged primarily so that the people of the United States might see these weapons and gain an understanding of our military progress. It gave the public at large, for the first time since the war began, an opportunity to view at first hand much of the equipment which enabled the Air Forces to help win the war. Many of the new weapons were superior to any our enemies had to offer.

These weapons were not developed overnight; their high quality was the result of continuous research. The center of all Army Air Forces' research and development work was at Wright Field during the war. New weapons were not necessarily conceived at Wright Field, but their research, development, and production were supervised and coordinated there. Industry, the universities, and other branches of the Army, such as the Signal Corps, Chemical Warfare Service, and Ordnance Department, also contributed to the completed development.

Bombardment Airplanes.—In one of General Arnold's recent reports he listed as used during the war "bombers capable of carrying 20,000 pounds of bombs to targets 1,600 miles away at speeds of 350 miles an hour and altitudes of over 35,000 feet." He was referring to the B-29 very heavy type of bomber used against Japan by the Twentieth Air Force.

The B-29 and the corresponding B-32 aircraft were shown at the Wright Field exhibit on the ground and in the air. There were also shown on the ground the types superseded by the B-29 and B-32. The superseded types were the more familiar Boeing B-17 and Consolidated B-24 heavy bombers whose speed, range, altitude, and bomb capacity were considerably below that of the B-29.

The B-17 and B-24 bombers were used in tremendous numbers in the European and Mediterranean Theaters and to a lesser extent in the Pacific. They were probably the most important air weapons used by U. S. Air Forces in the European Theater.

Although the B-29 airplane was comparatively new and not familiar to many the people who saw it at the exhibit, this type is already being superseded, according to General Arnold's report, by "jet-propelled bombers capable of flying 500 to 600 miles an hour to targets 1,500 miles away at altitudes of over 40,000 feet."

Yet, according to General Arnold's report, "development of even greater bombers capable of operating at stratospheric altitudes and speeds faster than sound and carrying bomb loads of more than 100,000 pounds already is a certainty. These aircraft will have sufficient range to attack any spot on the earth and return to a friendly base."

IT will be Wright Field's duty to supervise the research and development connected with these newer types of airplanes, and the Ordnance Department's to share in the development of the guns, bombs, and rockets they will carry.

Fighter Airplanes.—At the Wright Field exhibit there were shown, both on the ground and in the air, the following fighters: The Lockheed P-38 Lightning, the Republic P-47 Thunderbolt, and the North American P-51 Mustang, as well as the Lockheed P-80 Shooting Star. The first three are conventional types of propeller-driven fighter airplanes. They were used in the European Theater to drive enemy airplanes out of the air. They were used to escort the B-17 and B-24 bombers to the target and to protect them against enemy fighters. They were very successful in this rôle.

Their success was attributed largely to the modification which permitted

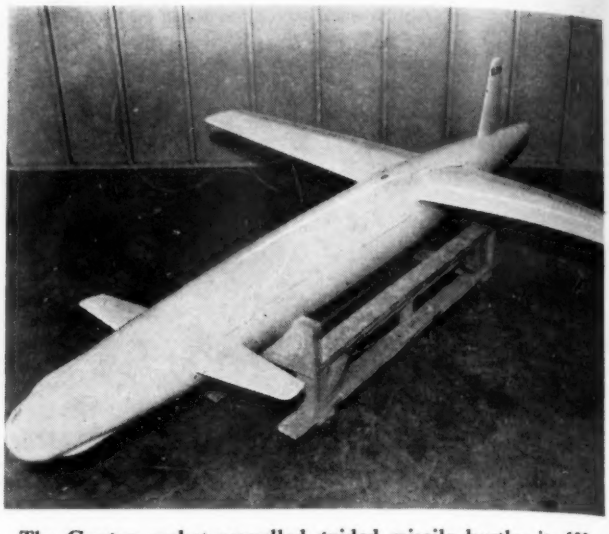
Press Assoc.

American jet-propelled bomb JB-1A carries 2 tons of explosives within its wings.

Colonel Schwartz is special assistant for armament, Engineering Division, Air Service Technical Command, Wright Field, Dayton, Ohio.

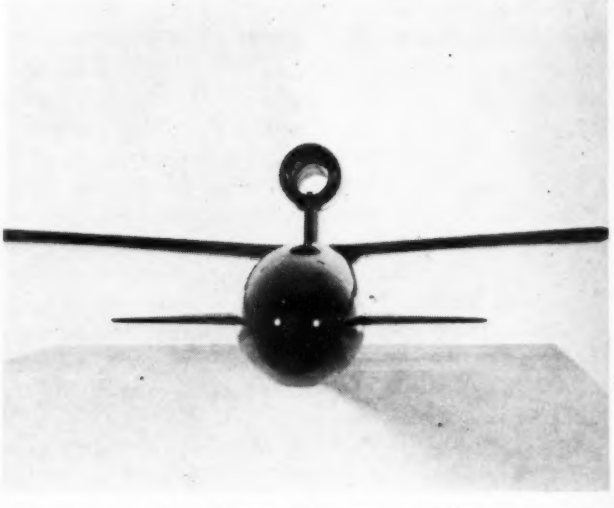
Guided Missiles—Weapons of the Future

The Glomb is a television-controlled glide bomb which can carry an explosive charge at a speed of about 300 m.p.h.



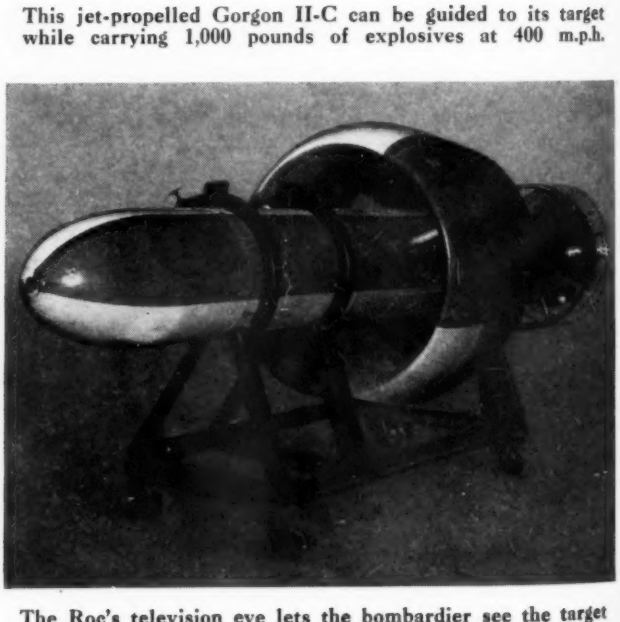
The Gorgon rocket-propelled guided missile hurtles its 100-pound special shaped charge through the air at 550 m.p.h.

Another guided missile is the Gargoyle which carries a 1,000-pound all-purpose bomb at a speed of over 600 m.p.h.

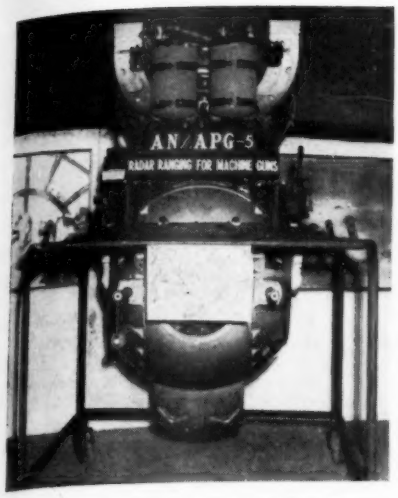


This jet-propelled Gorgon II-C can be guided to its target while carrying 1,000 pounds of explosives at 400 m.p.h.

Carried under the wing of a patrol bomber, this Bat missile is directed by its own radar installation when launched.



The Roc's television eye lets the bombardier see the target as he guides the missile by radio (USN-AAF photographs).



Radar equipment for aircraft guns.

them to change from short-range interceptor fighters to long-range escort fighters. This change was directly due to the addition of droppable gasoline tanks which were carried on the bomb racks of the fighter airplanes. In its strafing capacity the P-47 used bombs and rockets as well as machine guns.

General Arnold says in his recent report: "The conventional fighters are capable of speeds of 500 miles an hour, combat ranges of 1,300 miles, and effective ceilings of 35,000 feet. Improvement of our jet fighters may well produce within the next 5 years aircraft capable of the speed of sound and of reaching targets 2,000 miles away at altitudes of above 50,000 feet."

The Lockheed P-80 Shooting Star, among the first of our jet-propelled fighters placed on the production line, was flown at the exhibit simultaneously with the P-38, P-47, and P-51.

Bombs.—Bombs of all sizes, from the 4-pound to the 22,000-pound, were shown at the exhibit. Small incendiaries and parachute bombs were shown in cluster forms. The 12,000- and 22,000-pound size were developed by the British for use as "earthquake" penetration bombs. We made them for the British during the war. Toward the latter part of the conflict we began to produce some for use by American air forces. The larger bombs of 45,000-pound size which are now under consideration were not shown at the exhibit. Security restrictions precluded the exhibition of any model or sample of the atomic bomb.

Bomb Sights.—There was a display of various bomb sights from the earliest to the latest Norden M9. The Sperry bomb sight was also shown. These were the sights which were regarded as so highly secret during the early stages of the war because of their reputed accuracy. The Norden sight was used throughout the war as the principal bomb sight in light, medium, heavy, and very heavy bombardment airplanes and was even used in some fighter bombers.

Radar bomb-aiming equipment and methods were also shown. This equipment makes use of the reflection of very short length radio waves from the earth's surface as indicated on a radar scope. It was used in Europe and in the Pacific in bombing through overcast and for night bombing when the target was not visible to the bombardier. The accuracy of this type of equipment has improved continuously since it was first introduced in the European Theater.

ALSO demonstrated was a supersonic training table which is used to train radar (sometimes known as "Mickey") operators. This substitutes a small-scale relief map and high-frequency sound waves for the actual terrain and the radar waves. It gives the operator training almost equivalent to that obtained when flying with the radar equipment.

Loran, another radar aid to overcast bombing, was shown. This is a long-range radar navigational procedure in which the bomber is guided to the desired position over the target by radar waves from transmitting beacons located on the ground.

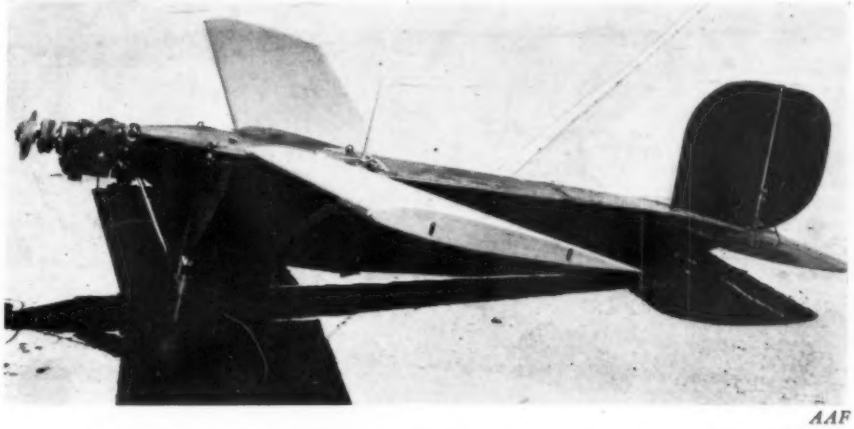
Gun Turrets.—The remotely controlled turrets of the B-29 bombardment airplane were exhibited in a wooden mock-up. The B-29 was the first of our heavy bombers designed to include a completely centralized fire control system capable of firing the guns of more than one gun position from a central point. Remotely controlled guns are desirable for the pressurized type of fuselage of the B-29 airplane.

A mock-up of an A-26 light bomber, as well as a completed airplane on the ground and in the air, was also shown. This was one of our best-liked light bombers used during the war. It also had remotely controlled guns aimed by means of a periscopic sight used with remote-controlled turrets which was something new in airplanes.

Aircraft Gunnery Trainer.—All through the war a need was felt for more adequate methods of training flexible gunners. Various simulated training devices such as the Jam-Handy trainer and others were developed. Sleeve targets could be used, but they slowed down the target plane. Camera missions could be flown but these failed to give the student gunner any feeling of reality.

It was desired therefore to develop either a bullet that could be safely used against another aircraft or an aircraft so armored that it could be safely used as a target.

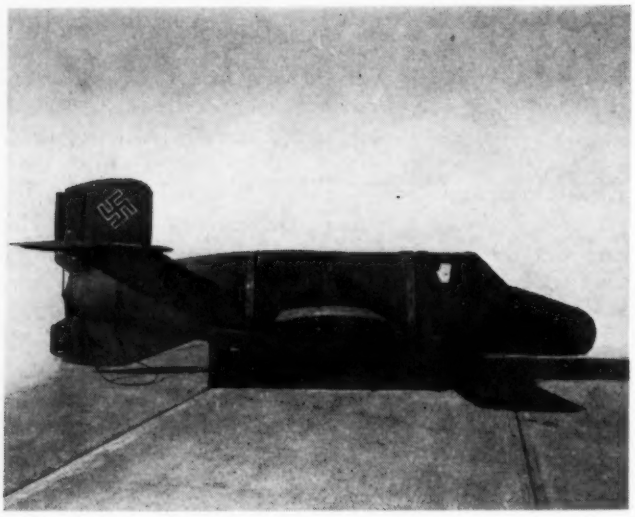
The solution was reached midway between these two ideas. The Bell P-63 airplane, a modification of the P-39, was given an armor plating of aluminum running from .090 inches to three-eighths of an inch thick. Bullet-proof glass was also provided. At the same time a bullet was developed with sufficient weight and consistency to have good ballistic properties, but sufficiently fragile to crumble on impact with the target plane. Because the target plane was weighted down with armor, its speed was slowed to 225 miles an hour. To maintain the proper relationship between speed of fighter, bullet, and



AAF

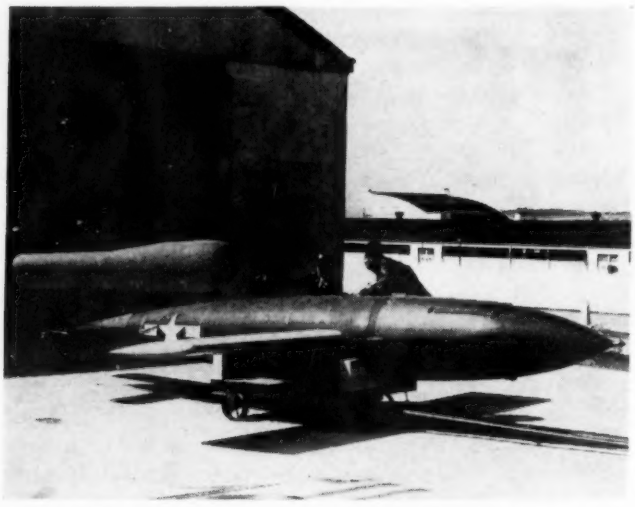
The radio-controlled OQ2A target airplane is used in antiaircraft and B-29 training.

German Jet and Rocket Craft



The Natter single-seat rocket-propelled interceptor has a speed of 600 m.p.h. and carries 24 rockets in the snub nose.

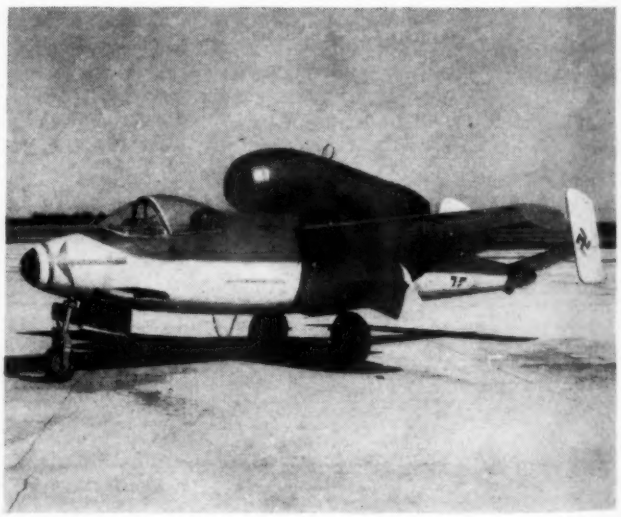
The ME-163 single-place interceptor is propelled by a liquid-fuel rocket motor to a height of 32,800 feet in 3 minutes.



The JB-2, American version of the German V-1 bomb, is equipped with a pulse-jet engine mounted in the long tube.

The ME-262 fighter is powered by 2 Junkers jet-turbo engines which give it a speed of 550 m.p.h. and a 400-mile range.

A rocket-propelled sled launches the JB-2 easily from a 50-foot ramp. Sled drops off when the rockets are exhausted.



The HE-162 has a top speed of 725 kilometers an hour with its single jet engine. It is armed with two 30-mm. cannon.

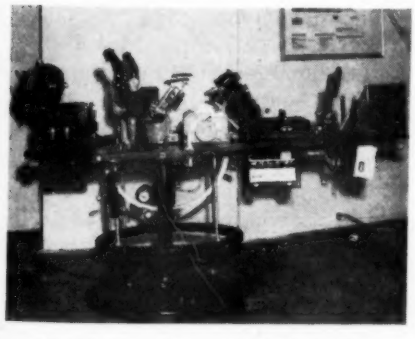
bomber, the speed of the latter was correspondingly slowed to 160 miles an hour. This combination was extensively used for the training of flexible gunners in this country.

Radio-Controlled Target Airplane.—One of the OQ radio-controlled target planes was on display. This is a small high-wing monoplane powered by a 2-cylinder engine, driving a fixed-pitch wooden propeller. Once the engine is started, the plane is flown and maneuvered from the ground (or from controls carried in an ordinary aircraft) by radio control. Its speed and maneuverability are such that it provides good target practice for antiaircraft gun crews.

When it is desired to land the plane, the operator causes the controls to stop the engine and release a parachute which lowers the plane gently to the ground. Should the radio-receiving equipment on the plane be hit during target practice, the controls operate automatically to stop the engine and release the parachute. Many of these airplanes have been used for training.

These target airplanes are of especial interest since the equipment used in their remote control by radio is somewhat similar to that which may be used in the guided missiles of the future. This development has thus served the immediate purpose of providing targets for antiaircraft, and aërial gunnery practice and a long-range purpose of providing a tested method of remote control for missiles.

Buzz Bomb.—The JB-2, the American copy of the German V-1 buzz bomb, received much attention. A



The C-1 autopilot used in bombing.

completely assembled bomb was on display in the open while at another place one was shown disassembled and partially packed for shipment. Off by itself —for all too obvious reasons—a buzz-bomb engine (or pulse-jet engine as it is properly called) was operated at frequent intervals.

This engine started with a tremendous bang and pulsed with a shuddering roar that could be heard all over the field.

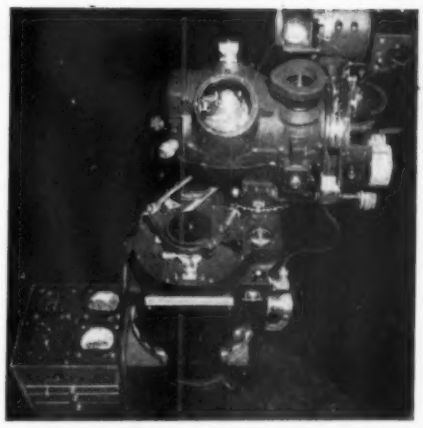
One feature which has been developed beyond its original state is the launching ramp. The Germans used a very complicated construction which required a solid foundation and took considerable time to erect. Wright Field developed a portable ramp only forty feet long—about one-quarter the length of the German ramp—and mounted it on a trailer. The American ramp uses rocket launching where the German ramp used the energy liberated by the decomposition of hydrogen peroxide.

THE controls for the buzz bomb were also on display. These included the compass, the autopilot, the air log, the servomotors, and the accessory devices. These were mounted on a platform, showing their relative positions in the bomb. The twin-jet bomb, shown at the top of p. 187, was built by the Northrop Corporation and tested by the Army. Production was later changed to the JB-1A jet bomb also shown on p. 187.

German V-2 Rocket.—The German V-2 long-range rocket was also on exhibition, standing upright on its base as if for launching. Nearly forty-six feet high, it formed quite a landmark. The body has a maximum diameter of 5½ feet, while the maximum diameter over the fins is 12 feet. This was the type of rocket which the Germans used both against England and against Liége, Brussels, and Antwerp. When loaded with 8½ tons of fuel its total weight was more than 12 tons. The rocket carried both the alcohol it used as a fuel and the oxygen (in liquid form) to permit combustion of this fuel.

It was powered by a jet engine developing a maximum thrust of over thirty tons—great enough to make the rocket self-launching. The engine was normally in operation about 65 seconds, and the maximum range of the bomb was about 200 miles. It made this trip of 200 miles in some 5 or 6 minutes, attaining a height of possibly 70 miles and striking with an impact velocity which reached a speed of around 4,000 feet a second.

The impact velocity is so much higher than the speed of sound that



The Norden bomb sight and stabilizer.

the rocket would strike and the one-ton war head detonate before any one could hear the rocket approaching. This was in marked contrast to the V-1 in which the noise of the approaching bomb was heard for minutes before the impact.

Natter.—The allied air superiority caused the Germans to pay more attention to defensive weapons. In particular, they had need of missiles or of aircraft capable of intercepting our bombers. One of their attempted solutions was the "Natter" which was shown at the exhibit. This was a single-seat, midwing, rocket-propelled plane designed for almost vertical take-off. It required no runway or landing field, and its pilot needed only a minimum of training time. He had only to learn to fly and to shoot.

This plane was largely of wooden construction requiring very little specialized equipment and manufacture and was intended for mass production. It was propelled in flight by essentially the same rocket engine as was used in the ME-163. Take-off was assisted with two solid-fuel rockets capable of giving a thrust of 2,000 pounds each for a period of 12 seconds. Acceleration during this time was over two *g*, dropping to less than one *g* after the rockets had burned out.

The Natter could climb at a maximum speed of over 400 miles an hour, achieving this in a little over one mile of flying. Its maximum duration of flight was about two minutes. Its horizontal cruising speed at 16,000 feet was about 600 miles an hour. Upon nearing the target the Natter pilot jettisoned the streamlined nose covering, exposing twenty-four rocket launchers. These were fired in one burst, after which the pilot was supposed to escape from his

craft. A separate parachute was supposed to land the rocket engine safely so that it might be used over again.

Japanese Suicide Bomb.—One of the Japanese suicide bombs, the Baka, was on display. This is a low-wing monoplane, about the same size as the German V-1 buzz bomb, with three rocket units built into the fuselage and using solid fuel. The aircraft is primarily a glide bomb. The rockets are only used to speed up impact velocity or for evasive action. Instead of using a preset autopilot like the buzz bomb, or a remote-control unit like the more advanced guided missile, the Baka was piloted by a man who rode to his death along with the 2,600-pound war head. The Baka was intended for launching from a bomber. It has a wing span of 16½ feet, an over-all length of 20 feet, and a maximum range of about 55 miles. Speed on impact may be as high as 600 miles an hour. The 2,600-pound war head is loaded with 1,100 pounds of trinitroanisol.

Water-Injection Engines.—One of the demonstrations which interested the crowds was increasing the power of an aircraft engine by injecting water into the cylinders. A number of aircraft engines were shown which had a twenty-five to thirty per cent increased horsepower rating as a result of the use of water injection. The heat absorbed in vaporizing the water cools the engine, providing additional control of combustion to a point where more fuel per cycle can be safely burned.

Assisted-Take-Off Rockets.—These may be used for assisting in airplane take-off where only a comparatively short runway is available. They may also be used when the airplane takes off with an extra-heavy load. The rocket equipment, sometimes carried on external bomb shackles, may be released after take-off and recovered after descending by parachute to the ground or water. The type of rocket-assist equipment shown uses an acid-aniline reaction. The fuel components are carried in separate tanks and are mixed in the combustion chamber. The resultant reaction produces the necessary high pressures for rocket propulsion. The gases escape through rocket nozzles of conventional design.

Pulse-Jet Engine.—The display of the pulse-jet engine as used on the German V-1 buzz bombs has been described previously. There were in addition some displays showing cutaway sections of the pulse-jet engine and charts indicating its mode of operation. The cycle of operation is essentially as follows:

Assembling the German V-2 rocket.

Air is rammed into the forward end of the combustion chamber by the motion of the engine in flight. The air mixes with the atomized fuel which enters through a set of fuel nozzles. This mixture is ignited by the residual flame left over from the previous cycle of operation. The combustion proceeds with explosive rapidity, building up an internal pressure which closes the air inlet valves.

These inlet valves consist of thin spring-steel leaves which are pressed back against the inlet ports in the manner of check valves. The exploding gases thus have a solid forward wall to press against while the tail of the combustion chamber is open. This provides the forward thrust of the engine. As the burning gases expand and escape out the tail of the engine, the internal pressure falls and the check valves at the forward end open, allowing fresh air to enter and the cycle to be repeated.

Turbo-Jet Engine.—With the demand for increased speed and with the requirements for more powerful engines, the trend in design is toward the turbo-jet. The mode of operation is substantially the same in the various models. Instead of releasing the exhaust gases through a venturi throat directly into the atmosphere as would a pulse-jet or a ram-jet, the gases are first made to operate a turbine. This turbine drives a pump which draws in the air, compresses it, and delivers it to the combustion chamber.

Ram-Jet Engine.—The fighting planes of the future will require speeds greater than that of sound. The engine which gives greatest promise of providing propulsion at such high speeds is the ram-jet (or athodyd) engine. This engine provides maximum efficiency at ultrahigh speeds, much greater thrust per unit frontal area, and light weight and simplicity of construction. This results in greater horsepower per unit weight of engine. However, it is unable to function at all at low air speeds and, consequently some means must be provided to bring the aircraft up to a certain minimum speed before the ram-jet engine can function.

Azon.—Azon is one of the new weapons developed during the war. It consists of a special tail assembly attached to a standard bomb. This tail contains a radio receiver, a gyroscope, and special motors by means of which the tail surfaces can be moved. The gyroscope, through the motors and ailerons of the tail, keeps the bomb from rolling about its axis as it drops.

The bombardier, after releasing the bomb, can steer it to left or right by signals transmitted by radio.

Roc.—The visitor discovered that Roc, instead of being a mythical bird, was a guided missile. This is a 1000-pound bomb with a nose extension housing a television eye and a tail extension housing controls. Instead of using the conventional type of controllable tail surfaces, it is steered by an annular airfoil or wing surrounding the fuselage. (The missile looks like a bomb sailing through a bottomless barrel.)

A scope in the bombing plane allows the bombardier to observe what the Roc is seeing with its television eye. The bombardier can then guide the bomb in both range and azimuth by radio control.

Glide Bomb.—Another guided missile is a glide bomb carrying a 2,000-pound war head. In appearance it remotely resembles a B-24 bomber. Like the Roc, it carries a television eye and a radio transmitter which carries the view seen by the eye back to a scope in the launching aircraft. The operator has a "stick" control by means of which he can steer the bomb up or down, right or left as desired.

All this highly technical equipment emphasized the recent statement of Gen. George C. Marshall: "The necessity for continuous research into the military ramifications of man's scientific advance is now clear to all."

To Keep America Strong

The A.O.A. Plans for Preparedness

This report of the Association's Committee on Aims and Organization was presented to the board of directors at a special meeting on November 25, 1945. It was approved unanimously and is presented herewith to the members of the Association together with the proposed constitution and by-laws about which they are asked to register their decision.

NO other organization devoted to the national security has a more stirring record of patriotic achievement than the Army Ordnance Association in peace and in war. Its contribution to victory has been unique. The steadfastness, energy, and realism with which it has performed its mission during the past twenty-five years are indicative of the patriotic zeal of all who have assisted in this high enterprise.

The national-security problems which will face our country in the years to come, particularly from the standpoint of scientific and industrial preparedness, will dwarf those of the past quarter century. Our Association in strength of numbers, adequacy of organization, and determination of leadership must meet this challenge, continue to raise its sights, and take its place in the forefront of those forces in our country to whom our people will look for counsel and guidance.

	1928	*1945*
Publications	1	4
Members	3,386	43,125
Subscribers	450	1,880
Advertisers	6	150
Posts	11	32
Net assets	$27,194.64	$982,000.00
Pay roll	$ 7,800.00	$ 45,000.00

Table I. Growth of the Army Ordnance Association from 1928 to 1945.

Scientific and industrial preparedness looms larger with each passing year. Ours will be the privilege and responsibility to help keep our country and our industry strong for peace!

The Record.—The Association was founded in 1919, incorporated in 1928. The growth of Ordnance activities in peace and in war is shown by the facts in Table I. Simultaneously, the growth and development of the Ordnance Department, U. S. Army, expanded phenomenally to meet its wartime responsibilities as indicated in Table II.

Col. H. A. Gidney

In October 1920 the Association held its first election of officers and directors. The present president, first vice-president, treasurer, and four national directors have held office uninterruptedly for nearly twenty-six years, and the present counsel, second vice-president, and four national directors have held office uninterruptedly for nearly twenty years. The contribution to our national security and to ultimate victory in World War II made by these Association stalwarts is beyond calculation. Aside from any gratitude toward these founders, it is evident that their continuing counsel and support are substantial assets to the Association, and any plan for the future of the Association and its mission should take proper cognizance of their service. To them and to all charter members of the Association these words of Lieut. Gen. L. H. Campbell, Jr., Chief of Ordnance, apply with special meaning:

"Of the Army Ordnance Association I can repeat what I have said publicly about it on many occasions. It has been, is now, and I am confident always will be, the vanguard of industrial preparedness in this country. Despite its important record during the past quarter of a century, its greatest service to our country is yet to be performed. As a technical and scientific society devoted solely to the interests of industrial preparedness it will be looked to in the days to come to lead the thinking, to assist in the planning, and to preserve the doctrines of armament research, production, and maintenance as we have learned them in this war" ("Pattern for Victory," ARMY ORDNANCE, July-August 1944).

In view of conditions brought about by the war and so illustrative of the principles for which the Association stands, it is obvious that a great opportunity for service confronts the Association in the coming years of peace. It is now our responsibility to move forward in such a way as will enlist the coöperation of *all* our citizens in the assurance of scientific and industrial preparedness for our country.

Committee on Aims and Organization.—Accordingly, a Committee on Aims and Organization was appointed by the board of directors of the Association at their annual meeting in New York City, February 14, 1945. In order that the committee should represent the points of view of the entire Association and that it should profit by wide and full deliberation, the committee membership consists of the presidents of the thirty-two local Posts of the Association and two national directors, K. T. Keller of Detroit, Mich., and Col. James L. Walsh of New York, N. Y., under the chairmanship of Col. H. A. Gidney, former president of the Pittsburgh Post and a national director of the Association. The complete membership of the committee is shown in the box on p. 194.

In order that the general committee might function speedily and effectively, the chairman appointed a subcommittee consisting of Col. H. A. Gidney, chairman; Edward T. Gusheé, R. E. Gillmor, Col. James L. Walsh, and Col. L. A. Codd, secretary. The subcommittee met first in Pittsburgh on April 25, 1945. Subsequently the subcommittee held lengthy informal conferences in New York on June 15 and October 18, 1945.

	1928	*1945*
Ordnance officers	314	27,885
Ordnance enlisted men	2,342	240,000*
Ordnance civilians	5,899	178,608*
Ordnance plants	6	153
Men in plants	*Not available*	93,296*
Women in plants	" "	85,310*
Annual expenditures	$12,179,856	$12,172,000,000

******Approximately*

Table II. Growth of the Ordnance Department, U. S. Army, from 1928 to 1945.

At the latter meetings the subcommittee had the benefit of the presence

and advice of the following gentlemen expert in the field of national organization: Brig. Gen. John Ross Delafield, counsel of the Army Ordnance Association; Col. C. E. Davies, secretary, The American Society of Mechanical Engineers, Inc.; D. D. Blanchard, Society of Automotive Engineers, Inc.; and James Cope, assistant to Mr. Keller and formerly of the staff of the Automobile Manufacturers' Association.

COL. H. A. GIDNEY, Chairman
National Director, A.O.A.
K. T. KELLER
National Director, A.O.A.
COL. JAMES L. WALSH
National Director, A.O.A.
COL. G. G. EDDY
Acting President,
Aberdeen Proving Ground Post
COL. ALLEN RUSHTON
President, Birmingham Post
H. P. RICHARDSON
President, Boston Post
L. P. WEINER
President, Central Illinois Post
BRIG. GEN. T. S. HAMMOND
President, Chicago Post
FREDERICK V. GEIER
President, Cincinnati Post
C. F. HOOD
President, Cleveland Post
F. J. SMITH
President, Empire Post
COL. F. H. PAYNE
President, Hartford-Springfield Post
D. D. DAY
President, Lone Star Post
EARL B. GILMORE
President, Los Angeles Post
E. T. GUSHEÉ
President, Michigan Post
FRANK HINDERLITER
President, Mid-Continent Post
HARRY DARBY
President, Midwest Post
COL. W. W. COLEMAN
President, Milwaukee Post
KARL E. VOGEL
President, Nebraska Post
R. E. GILLMOR
President, New York Post
L. S. OAKES
President, Northwest Post
C. JARED INGERSOLL
President, Philadelphia Post
J. D. BERG
President, Pittsburgh Post
A. F. PARKER
President, Puget Sound Post
COL. C. D. WIMAN
President, Quad Cities-Iowa Post
R. S. F. DEMENT
President, Red River Post
HENRY WINTER
President, Rocky Mountain Post
EDWIN B. MEISSNER
President, St. Louis Post
R. C. FORCE
President, San Francisco Post
W. R. ENGLAND
President, Texas Post
MAJ. GEN. G. M. BARNES
President, Washington Post

Committee on Aims and Organization, Army Ordnance Association

Functions of the Committee.—The committee conceived its functions to be:

(1) To review the aims and purposes of the Army Ordnance Association in the light of its greatly increased membership and its enlarged opportunities and responsibilities in connection with national security;

E. T. Gusheé

(2) To draft a restatement of the aims and objectives of the Association if, after due deliberation and mature consideration, this course were found by the committee to be necessary or desirable; and;

(3) To draft recommendations for submission to the board of directors covering (in conformity with the laws of the District of Columbia under which the Association is incorporated) such revisions of the articles of incorporation of the Association and of the constitution and by-laws as may be found necessary or desirable in order to provide the most effective organization for the purpose of achieving the broadened objectives as recommended.

Broadened Objectives.—The present constitution (Article II, Section 1) states the objectives of the Association as follows:

"The objectives of the Army Ordnance Association, hereinafter referred to in this constitution and in the by-laws as the Association, shall be:

"To assist in effecting industrial preparedness for war as being one of the Nation's strongest guaranties of peace;

"To keep available the highly specialized knowledge necessary for arming the manhood of the Nation by stimulating interest in the design, production, and use of armament;

"To promote mutual understanding and to effect coöperation with American scientists, inventors, engineers, and manufacturers in civil life and the Regular and Reserve Officers of our Armed Services concerned with armament preparedness;

"To make studies and reports upon special subjects pertaining to armament preparedness;

"To assist in developing and maintaining an efficient personnel, both commissioned and enlisted, for the units required by our armed services for the repair and maintenance of armament in the field in an emergency;

"To commemorate the services rendered by the industry of the Nation and by the officers, enlisted men, and civilian employees of our Armed Services in the wars in which the United States has been or may hereafter be engaged."

The committee recommends that the Association restate its general aims and purposes in the following language for use in its constitution and by-laws:

"The Army Ordnance Association shall be a patriotic, educational, scientific, and nonprofit-making organization of American citizens dedicated to effecting preparedness for national security as one of the Nation's strongest guaranties of peace, and to that end pledged to develop and perpetuate the necessary scientific, industrial, and military knowledge and experience for arming the Nation."

The committee also recommends that the following specific purposes be added to the present objectives, all to be stated in the text of the by-laws:

(1) "To bring to the attention of the people of our country the necessity for scientific and industrial preparedness and through meetings, conferences, and publications to spread a proper understanding of the need for adequate ordnance and related military preparedness.

(2) "To encourage programs of ordnance research and development particularly among private, industrial, educational, and research organizations in coöperation with the research agencies of the Ordnance Department and all other components of the armed forces.

R. E. Gillmor

(3) "To secure greater public understanding of the procurement, production, and other related phases of national preparedness, including those new developments of logistics necessitated by modern military strategy and tactics.

(4) "To encourage adequate military training throughout the Nation and the upbuilding of an adequate enlisted and commissioned reserve."

Membership.—The committee recommends that the Association should strike out into new and broader fields and strive to bring to the attention of *all men and women*—editors, authors, radio commentators, columnists, teachers, clergymen, doctors, and other public-opinion forming groups—the necessity for a sound program of scientific and industrial preparedness as our strongest guaranty of peace. At present the Association's membership is limited to *male* citizens having an interest in ordnance design, production, maintenance, etc. American citizenship and sympathetic interest in the preparedness objectives of the Association should become the test of eligibility for membership. The Committee favors the admission to membership of men and women who by qualification and experience have demonstrated their active interest in furthering national preparedness. The provisions for classes and election of the members shall be as provided in paragraphs 2 to 10 of the proposed by-laws.

K. T. Keller

Proposed Elective and Governing Bodies.—The committee recommends that the membership shall exercise control of the Association through the formation of a council which shall have the duty of electing the board of directors.

The council shall consist of (1) one member elected for a period of one year (or until his successor is chosen) by and representing each Post, (2) the three immediate past presidents, (3) the present charter national officers and charter national directors for life, if they consent to serve (see list of these officers and directors on this page), and (4) fifteen members at large to be elected for a period of one year by the council. The council shall choose its own chairman and vice-chairman and shall meet at the call of its chairman.

It is proposed that the government of the Association shall be vested in the *board of directors,* which shall consist of the immediate past president, the present charter national officers and charter national directors for life (seven in all, if they consent to serve), and nine members at large to be elected by the council. The board of directors shall meet at least once a year. The members at large shall serve for a full term of four years, but any member at large who shall have served for a full term of four years shall not be eligible for successive terms.

Exception to this procedure will be necessary at the first election when three members shall be elected for a period of two years, three for a period of three years, and three to serve the full term of four years. After the first election (1946) there will be no election the following year (1947) nor every fourth year thereafter (1951, 1955).

The president and two vice-presidents shall be elected from the members of the board of directors. The treasurer, counsel, and executive vice-president shall participate in the deliberations of the board of directors and its committees but shall have no vote.

The Board of Directors shall elect five of its members to serve as the *executive committee,* three of whom shall be the president and two vice-presidents. The committee shall transact necessary business on behalf of the board and by its authority between sittings of the board. The president, or in his absence either of the vice-presidents, shall be its presiding officer. The treasurer, counsel, and the executive vice-president and secretary shall be ex officio members of the committee. The committee shall function also as a finance committee.

The board of directors shall have the power to fill *vacancies* for unexpired terms in its membership.

Col. J. L. Walsh

It is recommended that the board of directors, among its other functions, consider the advisability of establishing an *advisory committee* to advise through standing and special committees on research, engineering, procurement, production, field service, logistics, legal, financial, accounting, and allied ordnance and industrial-preparedness problems.

President
BRIG. GEN. BENEDICT CROWELL
Cleveland, Ohio
Vice-President
COL. WILLIAM W. COLEMAN
Milwaukee, Wis.
Directors
BRIG. GEN. SAMUEL MCROBERTS
New York, N. Y.
COL. FRANK A. SCOTT
Cleveland, Ohio
COL. JAMES L. WALSH
New York, N. Y.
COL. ROBERT P. LAMONT
New York, N. Y.

Charter officers and national directors, Army Ordnance Association

The National Officers.—The committee recommends that the national officers shall consist of the president, first vice-president, second vice-president, treasurer, assistant treasurer, counsel, and executive vice-president and secretary, and such other officers as the board may elect. The president, first vice-president, and second vice-president shall be elected by the board of directors from among its members and shall serve for a period of two years. The treasurer, assistant treasurer, counsel, and executive vice-president and secretary shall be elected by the board from the membership of the Association and shall serve until their successors have been elected and qualified.

The *president* shall perform the duties usual to his office. He shall preside at meetings of the Association and of the board of directors; he shall be ex officio a member of all committees and all subcommittees thereof. In the absence of the president his duties shall devolve upon the vice-presidents in order of seniority. Under the guidance of the president, the two vice-presidents shall have the following additional functions:

The *first vice-president* shall have general supervision of the activities of local Posts and shall be charged with the responsibility of fostering their success.

The *second vice-president* shall have general supervision of such activities divisions as may be established to further the aims of the Association.

The *treasurer,* with the aid of the *assistant treasurer,* shall be controller of the finances and accounts of the Association under the direction of the executive committee.

The *counsel* shall be the legal adviser

to the council, the board of directors, the executive committee, and the national officers.

The *executive vice-president and secretary* shall have general administrative charge of the activities and programs of the Association and such other duties in keeping with those prescribed in the constitution and by-laws for the executive secretary as may be assigned him by the board of directors. The administration of national headquarters and all publications of the Association shall be under his direction. He shall act as secretary to the council, the board of directors, and the executive committee.

Local Posts.—It shall continue to be the policy of the Association to encourage the formation of Posts wherever there is sufficient interest to warrant the formation and continuation of such groups. They are a vital part of the success of the Association. Their general scope shall continue as at present. A minimum of 100 members shall be required to form a new Post. Their constitutions and by-laws shall be drawn in conformity with the wishes of the members of the Post, within the scope of the Association's constitution and by-laws and shall be subject to approval by the national board of directors. Local autonomy shall continue to be a guiding principle consistent with the national objectives and policies of the Association. Posts may organize such community groups within their confines as local interest may justify.

Posts shall receive annually from the national Association and out of the dues of each regular member, 50¢ from those members who pay on the annual basis, $1.25 from each of those members who pay on the 3-year basis, and $12.50 from each $100 company or group membership. All members shall receive all publications of the Association. It is recommended by the committee that the board of directors give study to the adequate financing of local Posts.

The combined activities of the Posts shall be under the general supervision of the first vice-president. Within national headquarters there shall be competent employed personnel whose special function shall be to assist in the programs, schedules, and activities of all Posts.

National Activities Divisions.—The committee recommends that, in conformity with policy adopted by the board of directors at their annual meeting in February 1945, national activities divisions of the Association continue to be organized. Establishment of these divisions is entirely permissive, and membership shall be by invitation of a member of the respective division and approval by the chairman thereof.

The Artillery Ammunition, the Small Arms and Ammunition, Fire Control Instruments, and Artillery Divisions are now in process of formation. Additional national divisions are under consideration as follows: Research and Development, Aviation Ordnance, Military Operations, Legal, Management, Automotive, Field Service, Military Training, Industrial Relations, Economic, Gages, Insurance, and Safety and Security. Others may be formed as conditions warrant, including activities divisions devoted to the perpetuation of the ideals and services of particular Ordnance military organizations; *e.g.*, the European Theater of Operations, the China-Burma-India Theater, the Fifth Army Ordnance Command, Mediterranean Theater of Operations, etc.

These national divisions shall be organized in conformity with conditions existing in each particular field of activity rather than according to any standard pattern. Each division shall be under the direction of a committee to be selected by the board of directors. It is anticipated that these divisions, through meetings, conferences, and discussions and in coöperation with local Posts, will keep the membership in close contact with ordnance progress in their particular fields. They will meet as divisions from time to time and will be available in an advisory capacity for such matters as may be presented either by the armed forces or by the Association.

The activities of national divisions ordinarily shall be under the general supervision of the second vice-president. Within national headquarters there will be competent employed personnel whose special function will be to assist in the programs, schedules, and activities of all divisions. It is recommended by the committee that the board of directors study the financing of national activities divisions through self-imposed contributions as well as specific appropriations from the board.

Membership Dues.—The committee recommends that regular membership dues remain at $4.00 a year, or $10.00 for three years. Group or company memberships likewise shall continue at $100.00 a year. Student, junior, or military membership shall be $2.00 a year. It is further recommended that Posts not have local dues but that they be permitted to raise additional funds for local activities by subscription, voluntary contribution, etc. It is also recommended that the board of directors from time to time allot to all Posts on a per capita basis such additional funds as may be warranted in the judgment of the board.

National Headquarters.—The committee recommends that national headquarters, under the direction of the executive vice-president and secretary, be strongly staffed to perform the following suggested functions according to careful budget control by the board of directors; (1) administration, (2) editorial, (3) operations, (4) public relations, (5) extension, (6) operation of the ordnance library. These functions are indicated on the organization chart attached (p. 198).

The committee, during its final deliberations, was cognizant of the various pending official proposals for realignment of the armed services, but felt it unnecessary to make specific recommendations in the confident knowledge that the board of directors will continue to guide the Association in such manner as to be of maximum service to the cause of national security under whatever plan of military organization ultimately prevails.

This report is intended to chart the course for greater national security through vigorous leadership which will be equipped and determined to cooperate with all similarly minded organizations of our country devoted to promoting necessary scientific, industrial, and military knowledge and experience for arming the Nation. This report, together with the accompanying chart and proposed revised constitution and by-laws, represents the general consensus, and has the endorsement of all members of the Committee on Aims and Organization. It is submitted in their behalf for your approval.

H. A. GIDNEY
Chairman, Committee on Aims and Organization, A.O.A.

The suggestions made by the Committee on Aims and Organization as detailed in the foregoing report have been incorporated into the proposed constitution and by-laws which follow.

Proposed Constitution of the A.O.A.

Together with the Proposed By-Laws

Following are the proposed constitution and by-laws of the Army Ordnance Association. All members are urged to read them carefully and then register their opinion as to their adoption or rejection by marking and sending in the ballot facing p. 192. No postage is required. The prompt coöperation of the A.O.A. membership will be appreciated.

ARTICLE I

Name and Objectives

Sec. 1. The name of the organization shall be Army Ordnance Association.

Sec. 2. The Army Ordnance Association shall be a patriotic, educational, scientific, and nonprofit-making organization of American citizens dedicated to scientific and industrial preparedness for the common defense as one of our Nation's strongest guaranties of national security and peace.

Sec. 3. In the accomplishment of these objectives the Association shall have all the powers set forth in its Certificate of Incorporation and granted to it by the Code of Laws of the District of Columbia.

Sec. 4. The executive offices of the Association shall be in the city of Washington, District of Columbia.

ARTICLE II

Membership

Sec. 1. Membership in the Association shall be open to all American citizens who are interested in the objectives set forth in this constitution and in the by-laws. The classes of membership and the fees therefor shall be as prescribed in the by-laws.

ARTICLE III

Government

Sec. 1. The government of the Association shall be vested in its board of directors and in an executive committee thereof, which shall perform the functions of a board of trustees in conformity with the Code of Laws of the District of Columbia. The board of directors shall be elected by a majority vote of the members of the Council.

Sec. 2. The Council shall have the sole function of electing the board of directors of the Association. It shall consist of (1) one member elected for a period of one year (or until his successor is chosen) by and representing each Post, (2) the three immediate past presidents, (3) the present charter national officers and charter national directors for life (if they consent to serve) and (4) fifteen members at large to be elected for a period of one year by the Council. The Council shall choose its own chairman and vice-chairman and shall have power to fill unexpired terms of its members. It shall meet at the call of its chairman but, if necessary, its business may be transacted by letter. A majority vote of its members shall be necessary for election to membership on the board of directors.

Sec. 3. The board of directors, five or more members of which shall constitute a quorum, shall have control of the affairs of the Association and, within the limits of the constitution, shall have the power to initiate and execute any measures whatsoever which in its judgment seem necessary or expedient to further the interests of the Association and achieve its objects.

The board of directors shall consist of the immediate past president, the present charter national officers and charter national directors for life, and nine members at large. The board shall meet at least once a year. Members at large shall serve for a full term of four years and shall not be eligible for successive terms. Exception to this procedure will be necessary at the first election after the adoption of this Constitution when three members shall be elected for a period of two years, three for a period of three years, and three to serve the full term of four years. The treasurer, counsel, and executive vice-president and secretary need not be members of the board of directors and shall participate in the deliberations of the board of directors and its committees but if not members of the board shall have no vote at meetings of the board.

The board of directors shall elect five of its members to serve as the executive committee, three of whom shall be the president and the two vice-presidents. The committee shall transact necessary business on behalf of the board and by its authority between sittings of the board. The president, or, in his absence, either of the vice-presidents in order of seniority of service, shall be the presiding officer of the committee. The treasurer, counsel, and executive vice-president and secretary shall be ex officio members of the committee. The committee shall also function as a finance committee and as a board of trustees within the meaning of the Code of Laws of the District of Columbia.

Sec. 4. The board of directors shall have the power to amend the by-laws. It shall also have the power to fill unexpired terms of its members.

ARTICLE IV

Meetings

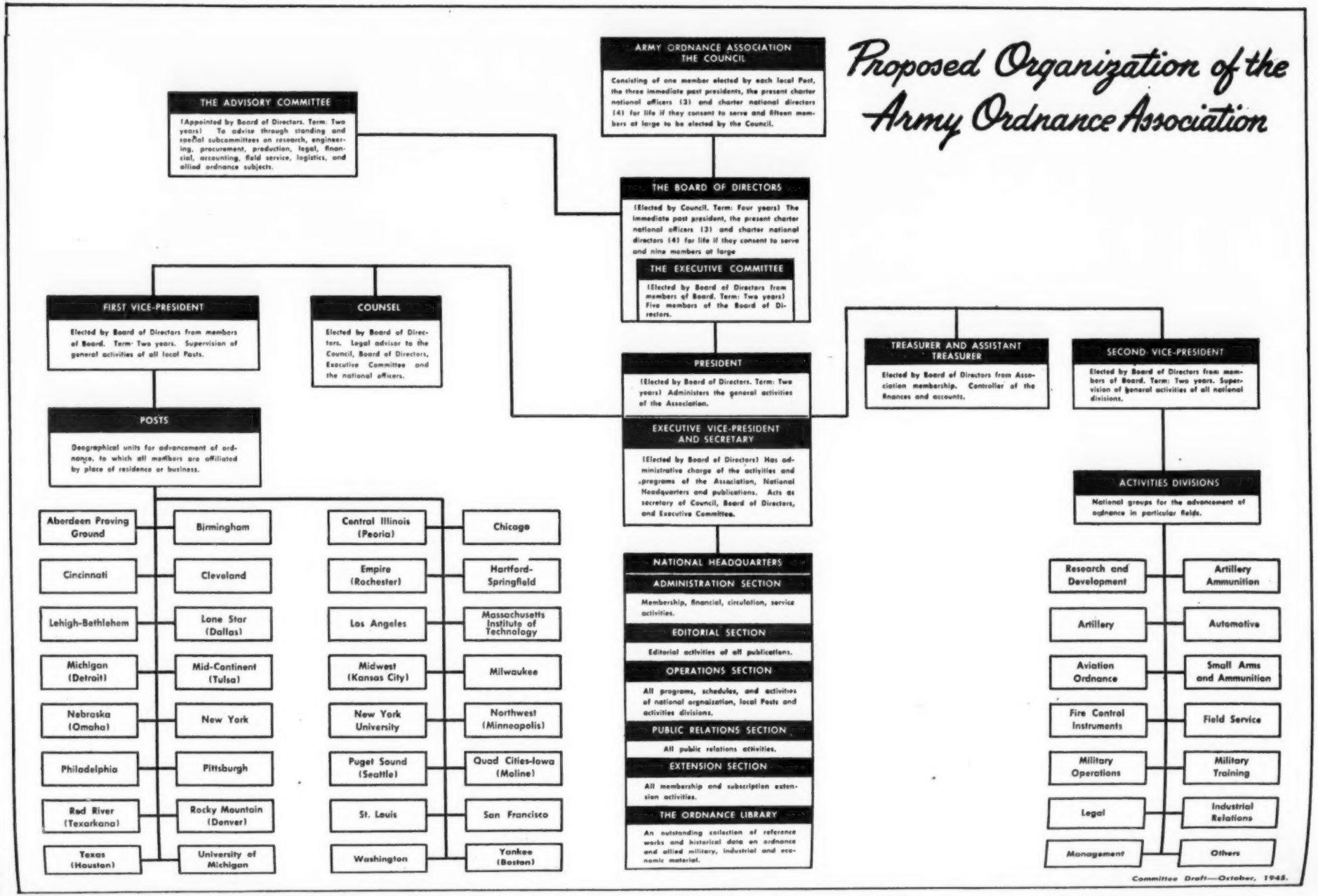
Sec. 1. The annual meeting of the Association shall be held at a time and place determined by the board of directors. In conjunction therewith there may be meetings devoted to the discussion of scientific, industrial, and military experience related to effecting preparedness for national security.

ARTICLE V

Corporate Obligations

Sec. 1. All obligations incurred by the Association shall be solely corporate obligations and no personal liability whatsoever shall attach to, or be incurred by, any member, officer, or director of the Association by reason of any such corporation obligations.

Sec. 2. Each director or officer, or former director or officer, shall be indemnified by the corporation against expenses actually and necessarily incurred by him in connection with the defense of any action, suit, or proceeding in which he is made a party by reason of his being or having been a director or officer of the corporation, except in relation to matters as to which he shall be adjudged in such action, suit, or proceeding to be liable for negligence or misconduct in the performance of duty; which indemnification shall not be deemed exclusive of any other rights to which he may be entitled under any by-law, agreement, vote of members, or otherwise.


Proposed Organization of the Army Ordnance Association
ARMY ORDNANCE ASSOCIATION
THE COUNCIL
Consisting of one member elected by each local Post, the three immediate past presidents, the present charter national officers (3) and charter national directors (4) for life if they consent to serve and fifteen members at large to be elected by the Council.
THE ADVISORY COMMITTEE
(Appointed by Board of Directors. Term: Two years) To advise through standing and special subcommittees on research, engineering, procurement, production, legal, financial, accounting, field service, logistics, and allied ordnance subjects.
THE BOARD OF DIRECTORS
(Elected by Council. Term: Four years) The immediate past president, the present charter national officers (3) and charter national directors (4) for life if they consent to serve and nine members at large
THE EXECUTIVE COMMITTEE
(Elected by Board of Directors from members of Board. Term: Two years) Five members of the Board of Directors.
FIRST VICE-PRESIDENT
Elected by Board of Directors from members of Board. Term: Two years. Supervision of general activities of all local Posts.
COUNSEL
Elected by Board of Directors. Legal advisor to the Council, Board of Directors, Executive Committee and the national officers.
PRESIDENT
(Elected by Board of Directors. Term: Two years) Administers the general activities of the Association.
TREASURER AND ASSISTANT TREASURER
Elected by Board of Directors from Association membership. Controller of the finances and accounts.
SECOND VICE-PRESIDENT
Elected by Board of Directors from members of Board. Term: Two years. Supervision of general activities of all national divisions.
POSTS
Geographical units for advancement of ordnance, to which all members are affiliated by place of residence or business.
EXECUTIVE VICE-PRESIDENT AND SECRETARY
(Elected by Board of Directors) Has administrative charge of the activities and programs of the Association, National Headquarters and publications. Acts as secretary of Council, Board of Directors, and Executive Committee.
ACTIVITIES DIVISIONS
National groups for the advancement of ordnance in particular fields.
Aberdeen Proving Ground
Birmingham
Central Illinois (Peoria)
Chicago
Cincinnati
Cleveland
Empire (Rochester)
Hartford-Springfield
Lehigh-Bethlehem
Lone Star (Dallas)
Los Angeles
Massachusetts Institute of Technology
Michigan (Detroit)
Mid-Continent (Tulsa)
Midwest (Kansas City)
Milwaukee
Nebraska (Omaha)
New York
New York University
Northwest (Minneapolis)
Philadelphia
Pittsburgh
Puget Sound (Seattle)
Quad Cities-Iowa (Moline)
Red River (Texarkana)
Rocky Mountain (Denver)
St. Louis
San Francisco
Texas (Houston)
University of Michigan
Washington
Yankee (Boston)
NATIONAL HEADQUARTERS
ADMINISTRATION SECTION
Membership, financial, circulation, service activities.
EDITORIAL SECTION
Editorial activities of all publications.
OPERATIONS SECTION
All programs, schedules, and activities of national organization, local Posts and activities divisions.
PUBLIC RELATIONS SECTION
All public relations activities.
EXTENSION SECTION
All membership and subscription extension activities.
THE ORDNANCE LIBRARY
An outstanding collection of reference works and historical data on ordnance and allied military, industrial and economic material.
Research and Development
Artillery Ammunition
Artillery
Automotive
Aviation Ordnance
Small Arms and Ammunition
Fire Control Instruments
Field Service
Military Operations
Military Training
Legal
Industrial Relations
Management
Others
Committee Draft—October, 1948.

ARTICLE VI

Amendments

Sec. 1. Amendments to this constitution or the certificate of incorporation may be proposed by a majority vote of the board of directors or upon petition addressed to the president and signed by not less than five per cent of the total number of regular members.

Sec. 2. Proposed amendments shall be submitted to the entire regular membership by letter ballot and shall be adopted if a majority of the votes cast are in favor thereof.

Sec. 3. Voting shall cease and the polls close on amendments to the constitution on a predetermined date not less than thirty (30) days after the ballots have been mailed to the members. The votes shall be counted by a committee of three tellers appointed by the president, and certified to the executive vice-president and secretary within fifteen (15) days after the polls have closed.

Sec. 4. Amendments, unless otherwise provided for, shall become effective upon receipt by the executive vice-president and secretary of a certificate of their adoption by the tellers.

BY-LAWS

Aims and Purposes

1. In conformity with Section 2 of Article I of its constitution, the aims and purposes of the Association shall be:

(a) To assist in effecting industrial preparedness for war as being one of the Nation's strongest guaranties of peace;

(b) To encourage programs for ordnance research and development, particularly among private, industrial, educational, and research organizations in coöperation with the research agencies of the Ordnance Department and all other components of the armed forces and to keep available the highly specialized knowledge necessary for arming the manhood of the Nation by stimulating interest in the design and production of ordnance matériel;

(c) To bring to the attention of the people of our country the necessity for scientific and industrial preparedness and through meetings, conferences, and publications to spread a proper understanding of the need for adequate ordnance and related military preparedness;

(d) To provide, when required, the services of competent committees to investigate and report upon special ordnance subjects and to encourage programs for the adequate understanding of the procurement, production, and other related phases of national preparedness including those new developments of logistics necessitated by modern military strategy and tactics;

(e) To encourage adequate military training throughout the Nation and the upbuilding of adequate enlisted and commissioned reserves;

(f) To promote mutual understanding and to effect coöperation with American scientists, inventors, engineers, and manufacturers in civil life and the personnel—Regular, Reserve, and National Guard—of the armed forces;

(g) To assist in developing and maintaining efficient personnel, both commissioned and enlisted, for the units required for Ordnance Field Service in the event of an emergency;

(h) To commemorate the services rendered by the industry of the Nation and by the officers and civilian employees of the Ordnance Department and of American science and industry in the wars in which the United States has been engaged.

Classes of Membership

2. Regular membership in the Association shall be open to all American citizens who are interested in advancing the knowledge of scientific and industrial preparedness and in the objectives set forth in the constitution and by-laws.

3. Life membership in the Association shall be open to all American citizens who are interested in advancing the knowledge of scientific and industrial preparedness and in the objectives set forth in the constitution and by-laws. Life membership shall continue during the lifetime of the life member and shall expire at death. It shall not be transferable.

4. Associate membership in the Association shall be open to all American citizens who are students in technical schools or colleges and to enlisted and noncommissioned members of the armed forces of the United States. Associate members shall not vote or hold office in the Association.

5. Company membership in the Association shall be open to all companies, firms, and groups controlled by American citizens who are interested in advancing the knowledge of scientific and industrial preparedness and in the objectives set forth in the constitution and by-laws.

Company members shall have the privilege of nominating ten of their employees —preferably key personnel who would be connected with ordnance development and production in time of war—for regular membership in the Association, and members thus nominated shall not pay individual dues. Company members shall also be entitled to a quarter-page advertisement in ARMY ORDNANCE, the journal of the Army Ordnance Association, during the term of said company membership. Company members who avail themselves of this latter privilege must submit all copy for publication to the editor of ARMY ORDNANCE for approval.

6. Honorary membership for life shall be conferred, in the discretion of the board of directors, upon persons who have rendered meritorious service to the cause of scientific and industrial preparedness. Honorary members shall be entitled to all privileges of regular membership except as otherwise provided in these by-laws.

7. The term "member" when used in the by-laws shall mean regular and life members only.

8. The election to membership of all classes shall be with the approval of the board of directors, and the decision of the board as to eligibility shall be final.

9. Any person desiring to become a member shall make written application to the executive vice-president and secretary. Such application shall be in such form and contain such data as may be prescribed by the board of directors. The applicant, if not commissioned in the military service, shall give the names and addresses of two persons competent to serve as references.

10. Any member may withdraw from the Association at any time by tendering his resignation in writing, but such resignation shall not become effective until said member shall have paid all financial obligations due the Association from him at the time of such resignation.

Membership Dues

11. Dues for the several classes of membership shall be as follows: (a) Life membership, $100.00; (b) Regular membership, $4.00 annually or $10.00 for three years; (c) Associate membership, $2.00 annually; (d) Company membership, $100.00 annually.

12. Every member of the Association shall also be a member of the local Post in the territory in which he resides. The local Post may collect whatever local dues may be assessed against its members. It may raise additional funds for local activities by subscription, voluntary contribution, and other appropriate means, but annual dues to the Association shall be collected by the Association in the usual manner.

13. A portion of the dues of members shall be remitted to each local Post for its members upon the payment by them of their annual dues to the Association. These are as follows:

(a) From life members upon the payment of the $100.00 life membership fee, $10.00 shall be remitted;

(b) From regular members who pay $4.00 annually, 50 cents shall be remitted. From regular members who pay at the special rate of three years for $10.00, $1.25 shall be remitted;

(c) From company members upon pay-

ment of the $100.00 annual dues, $12.50 shall be remitted;

(d) There shall be no refund to local Posts from the dues of associate members.

Officers

14. The president, elected from its own membership by the board of directors for a term of two years, shall perform the duties usual to his office. He shall have general supervision of the affairs of the Association; he shall preside at the meetings of the Association and of the board of directors; he shall be ex officio a member of all committees and of all subcommittees thereof. In the absence of the president, his duties shall devolve upon the vice-presidents in order of seniority of service, and in their absence upon the board of directors in the same order.

15. The first vice-president, elected from its own membership by the board of directors for a term of two years, shall have general supervision of the activities of local Posts of the Association and shall be charged with the responsibility of fostering their success.

16. The second vice-president, elected from its own membership by the board of directors for a term of two years, shall have supervision of general activities of all national divisions.

17. The counsel, elected by the board of directors, shall be the legal adviser to the board, the executive committee, and the officers.

18. The treasurer, elected by the board of directors, shall be the controller of the finances and the accounts of the Association under the direction of the board of directors. He shall render an annual report and such special reports as may be called for by the board of directors. The accounts of the Association shall be audited annually by independent auditors. However, in the discretion of the board of directors a certified public accountant may conduct the annual audit, his report to be made to the board of directors.

19. The fiscal year shall close on December 31st of each year.

20. The executive vice-president and secretary, elected by the board of directors, shall have administrative charge of the activities and programs of the Association, of national headquarters, and all Association publications. He shall make collections and disbursements under supervision of the board of directors, shall keep the roster of members and the record of the status of annual dues, shall be the keeper of the seal of the Association, and shall have custody of correspondence and records.

He shall be responsible that suitable arrangements are made for the annual and other meetings of the Association, of the Council, of the board of directors, and of the executive committee. He shall serve as secretary to each of these groups and shall be responsible for the record of their proceedings. He shall submit an annual report to the board of directors. He shall be responsible for the management of national headquarters and shall have the power to contract in the name of the Association for such services and supplies as are necessary for its operation.

Posts

21. Posts of the Association shall be formed wherever there is sufficient interest to warrant their continuation. A minimum of one hundred members shall be required to form a new Post. It shall be their general purpose to cultivate a more intimate understanding of ordnance subjects through meetings, plant visits, seminars, and reports on particular ordnance problems. Their constitutions and by-laws shall be drawn in conformity with the wishes of the members of the Post within the scope of the Association's constitution and by-laws and shall be subject to approval by the national board of directors. Local autonomy shall be a guiding principle consistent with the national objectives and policies of the Association.

Posts may organize such community groups within their confines as local interest may justify.

22. Upon petition signed by not less than one hundred members of the Association in any locality stating their desire to form a local unit for the more intimate achievement of the purposes of the Association, such unit to be known as a Post, the executive vice-president and secretary of the Association shall immediately authorize a meeting for such inauguration and the Association shall contribute to the organizing expenses of such Post the sum of $2.00 for each such petitioner, such payment to be, however, not over $200.00 in the aggregate.

When not less than one hundred members of the Army Ordnance Association shall have enrolled as members of such a Post, the Association shall issue a suitable charter thereto signed by the president and executive vice-president of the Association.

National Activities Divisions

23. Members of the Association shall also be eligible for membership in two of the national activities divisions. These divisions shall be in addition to the several local Posts of the Association and shall be devoted primarily to the advancement of knowledge, engineering practices, and production techniques relating to particular fields of ordnance.

24. National activities divisions shall be organized in conformity with conditions in each particular field of activity rather than according to any standard pattern. National activities divisions may also be organized to perpetuate the ideals of particular military organizations such as those which in the field had notable records of battle experience worthy of emulation.

25. Each division shall be under the direction of a committee to be selected by the board of directors. Through meetings, conferences, and discussions, and in coöperation with local Posts, they shall keep the membership in close contact with ordnance programs in particular fields. They shall meet as divisions from time to time and shall be available in an advisory capacity for such matters as may be presented for their study and report either by the armed forces or by the Association.

Restriction

26. No officer or enlisted man on the active list of the Army or Navy shall serve as a salaried employee of the Association, but this shall not prohibit the acceptance of articles from officers and enlisted men for use in the publications of the Association.

Elections

27. The Council shall meet at the call of its chairman. Members of the Council who are unable to attend a meeting in person may approve or disapprove, by letter, any action proposed.

The executive vice-president and secretary shall notify the chairman of the Council thirty days before the expiration of the term of any directors. In the case of casual vacancies in the Council, the chairman of the Council may make interim appointments.

Amendments

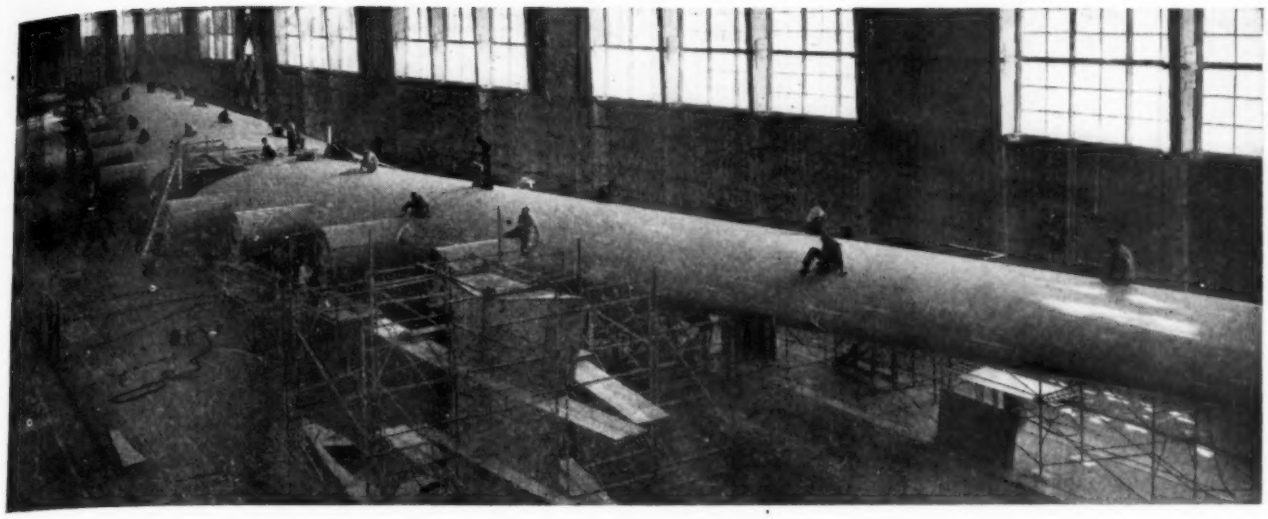
28. The board of directors, by majority vote of those present at a meeting, may make amendments to these by-laws.

Insignia

29. The insigne of the Association shall consist of an emblem having at its topmost part the American eagle with wings spread, below which shall be a shield upon which shall be superimposed in the center a shell and flame with the letters "U" and "S" on either side thereof. Above the shell shall be enscrolled the words "Army Ordnance Association."

Insignia in this form with ribbon and such modifications of it in the form of pins, badges, buttons, and rings shall be authorized by the board of directors for use of members. The ribbon shall be the traditional Ordnance colors, the center portion being scarlet bordered with yellow and edged with black.

30. The flag of the Association shall consist of the insigne as above superimposed upon a field of blue cloth. Under the insigne shall be a scroll on which shall be inscribed "Industrial Preparedness for Peace."



The Hughes H-4 Airplane

A Giant Cargo Craft Built Entirely of Wood

THE story of the Hughes H-4 airplane originated in 1942 at the height of the submarine menace to allied shipping. Cargo-carrying needs to transport vital war material overseas were mounting. Realizing the value of aircraft for this purpose, the Government showed interest in the development of extremely large flying boats that could handle the enormous quantities and units necessary to supply an army in the field of combat.

The experience in mass production of ships by Henry J. Kaiser and the interest in aircraft development of Howard Hughes were combined into the Kaiser-Hughes Corporation for this undertaking. With the selection of the Hughes Aircraft Company to do the design and construction of the experimental airplanes, the corporation was started on the vast project—the completion of the largest airplane on record.

The original proposal called for a single-hull flying boat of approximately 250,000 pounds. When the builders considered the airplane was to be designed around an Army 60-ton heavy tank, the present size and gross weight of 400,000 pounds were established.

Other specifications for the world's largest airplane decided on at this time were the following:

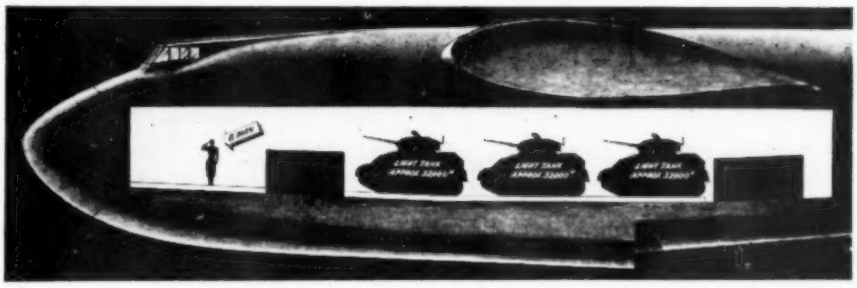
Wingspread: 320 feet (20 feet longer than a football field), 13 feet thick at hull; *Hull:* 220 feet long, 30 feet high (equal to a 3-story building), 25 feet wide; *Power:* 8 engines of 3,000 horsepower, each with 4-bladed propellers 17 feet, 2 inches, from tip to tip; *Fuel:* 14 tanks, each to hold 1,000 gallons of gas (approximately 42 tons of gas); *Speed:* High speed at sea level, 218 m.p.h.; cruising speed, 175 m.p.h.; landing speed, 78 m.p.h.; distance of take-off, 5,500 feet or slightly more than one mile; *Gross weight:* more than 200 tons (Martin Mars is 72 tons).

When finished, this airplane could carry one 60-ton tank or three light tanks. It could accommodate 350 hospital patients on stretchers with doctors, nurses, and medical troops.

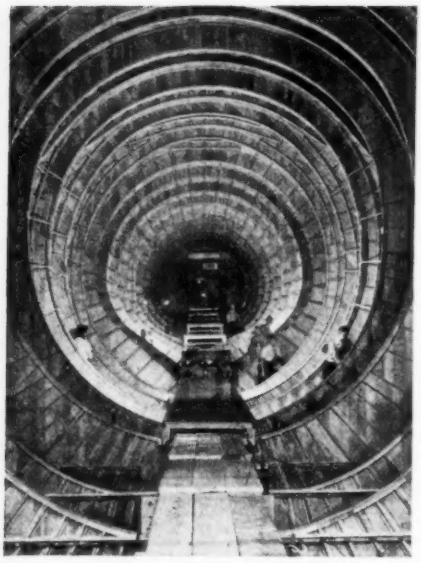
One of the unusual aspects of the Hughes H-4 is that it is built almost entirely of wood, the reason for this being the critical shortage of dural and aluminum at the time the preliminary negotiations on the contract for the airplane were made. Regular aircraft birch, purchased in the northern part of the Middle West—Wisconsin and Michigan—was selected because of past experiments with other planes and the strength-weight ratio. Also, spruce of the quality desired was scarce.

AIRCRAFT construction never before had required the handling of such large components, especially with wood design. Extreme precaution had to be taken and maintained to prevent the parts and assemblies from being affected by moisture and temperature changes. Outmoded methods and materials were found to be unsatisfactory, and many new wood-handling techniques were developed.

Three different types of resin glues are used throughout the airplane. The plywood used on the outside surfaces as well as in other parts of the structure is bonded with a phenol formaldehyde resin which is cured by heating to 300 degrees Fahrenheit. The laminate members, such as the stringers, longerons, and stiffeners were built up from veneers using a urea formaldehyde resin



The H-4 can carry 3 tanks, ammunition, and equipment totaling 120,000 pounds.



Interior of hull looking aft.

of the type curing at seventy degrees Fahrenheit or above. This same resin was also used for most of the assembly work. Another resin, the medium-temperature resorcinol formaldehyde type, became available after the project was well under way and was used in making the joints in the hull skin.

The hull is of all-wood construction with the exception of a few metal fittings. The skin, bulkheads, and frames are of all-birch construction while stringers are of composite birch and spruce design. The upper longeron is a ten by ten-inch piece of spruce almost one hundred feet long.

Glue pressure for skinning is obtained by nailing skins in place with thousands of small nails which are removed after the glue has cured. Approximately eight tons of these nails have been used. Single skin panels often require over 20,000 nails. To accomplish the task of driving and pulling nails, special nailing guns and nail pullers were developed by company engineers and shop men.

The cargo floor was designed to carry a load of 125 pounds per square foot. The supporting frames have been designed so that by laying the proper planks across the floor any heavy piece of equipment up to and including the Army's 60-ton tank can be rolled in under its own power and transported without dismantling. A ¾-yard power shovel can be transported if the "A" frame is removed from the top of the cab. The bottom skin is a half inch thick and is designed to take much higher bottom pressures than those used on smaller flying boats.

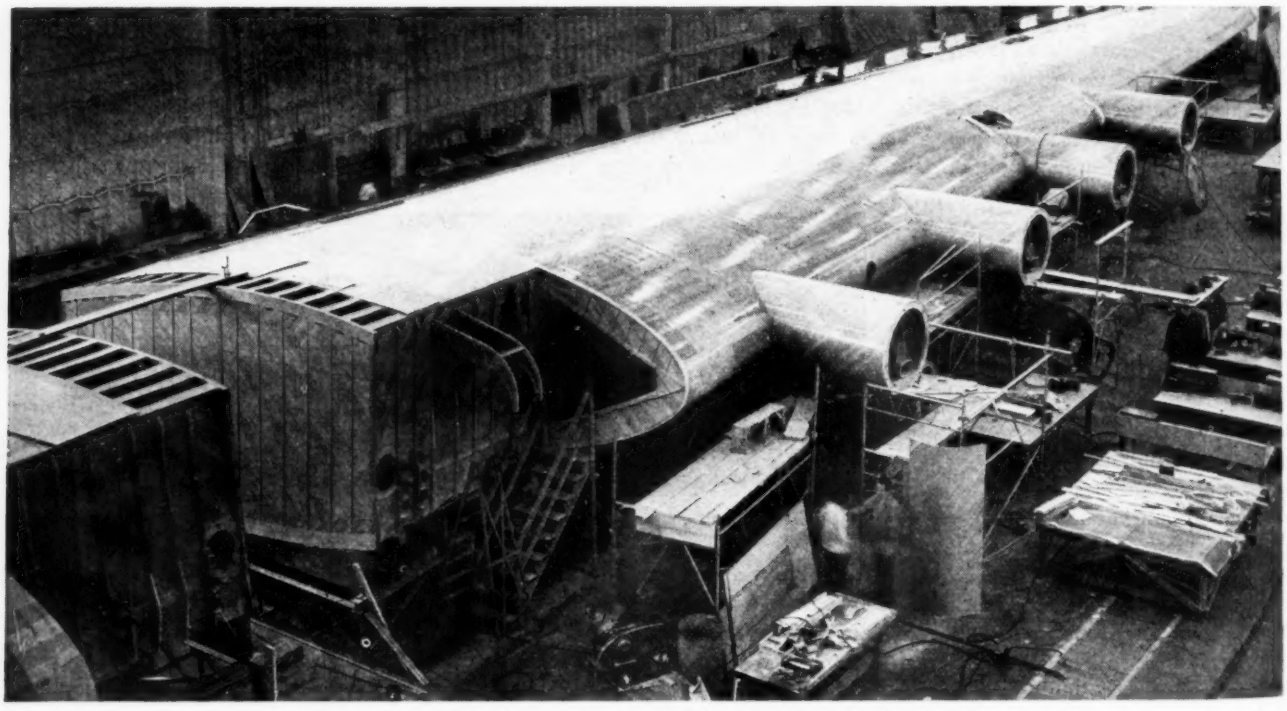
The hull below the cargo deck is divided into eighteen watertight compartments. If two-thirds of these were flooded, the ship would still remain afloat. The main gas tanks are housed in these compartments so that if a tank should leak the gasoline will not spread to other parts of the ship.

The exterior of the ship is finished with a special process developed by the company. It consists of one coat of wood filler, one coat of sealer which acts as a cement for a coat of thin tissue paper placed over it, two coats of spar varnish, and one coat of aluminized spar varnish. Tissue paper was applied by regular paper hangers.

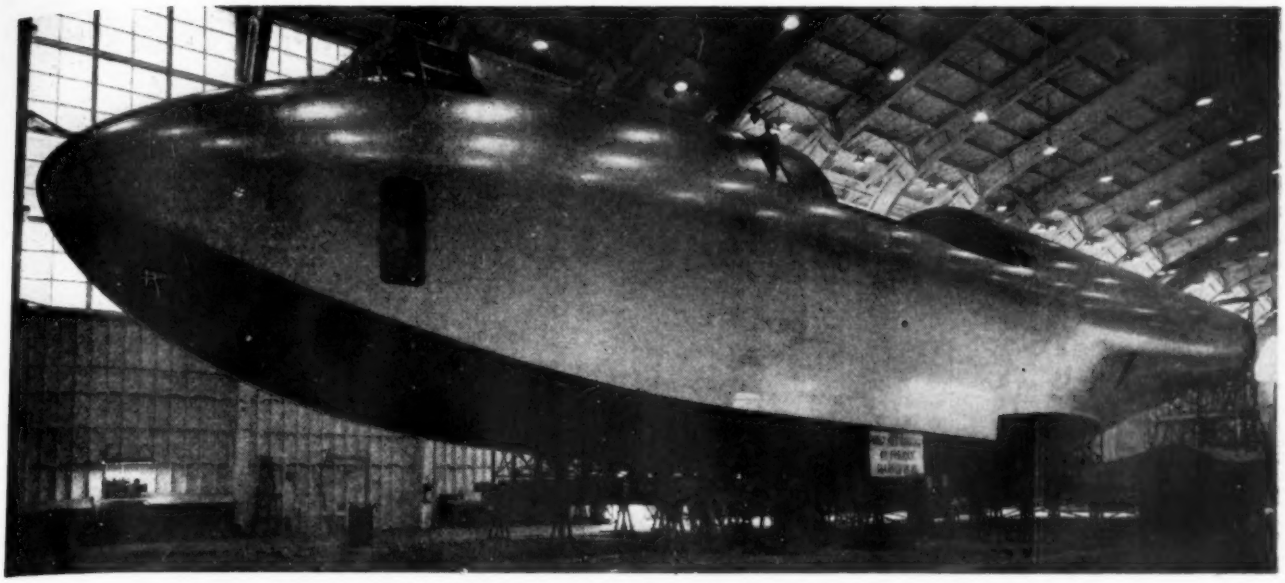
Eight of the largest air-cooled radial engines ever used are installed on the leading edge of the wing. Through a passage in front of the front spar and then through the nacelles and fire-wall doors, the flight mechanic may inspect and make minor repairs and adjustments on each engine. All fuel, oil, hydraulic, and pneumatic plumbing is routed along the spar, providing for quick inspection. The nacelle structures are all-wood and are mounted from the front spar by welded steel tube adapters. All cowling and other structure forward of the fire walls are metal.

A SMALL oil tank sufficient to supply the engine for a reasonable time is located in each nacelle and may be refilled at any time from a central oil reservoir by a semiautomatic control system. The engines are fitted with "jet stacks" in an effort to convert as much of the exhaust-gas energy into thrust as possible.

The fuel system for the airplane produced several problems which are not prevalent on smaller aircraft or are of such proportions that they could be disregarded. Fourteen huge fuel tanks of over 1,000 gallons each store fuel in



The 160-foot port wing, shown here under construction, is 13 feet thick at the center section.



The hull of the H-4 is 220 feet long; wings fit together in cutaway section in the center.

the hull. Two transfer pumps supply fuel from these tanks to a service tank in each wing. Each tank supplies fuel to four engines selected to give a lateral balance of power in the event that one tank, its booster pump or system fails.

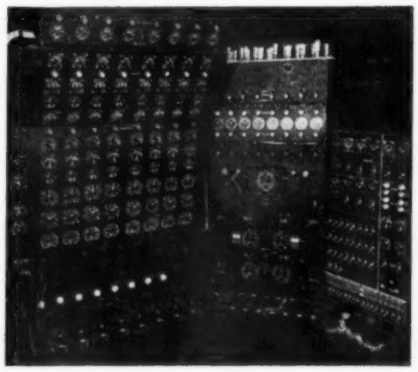
In addition to this regular fuel supply system a complete and separate system from the hull storage tanks is immediately available for emergency use, providing enough fuel at all engines for maximum power at the required pressure at the carburetor.

The control of eight engines, all of them located at greater distances from the flight engineer and pilots than ever before, was a serious problem considering the delicacy of adjustment and accuracy of motion required by engine controls.

THE engineers responsible for this task went to the railroading practice and borrowed from it the pneudynes, with a long record of reliability in brake control. The pneudynes are devices using compressed air for precisely transmitting very small motions at long distances. Furthermore, any position of the lever on the transmitting pneudyne is maintained accurately on the receiving pneudyne for indefinite periods of time, even if the atmospheric temperature and pressure change during flight, provided of course that compressed air is available.

Due to their immense size, the control surfaces cannot be operated by the human effort of a pilot alone, but are actuated by a hydraulic telecontrol system which transmits the pilot's controlling motions and amplifies his efforts many times, instantaneously, as they occur. The operating power is supplied by electrically driven, high-pressure hydraulic pumps which provide oil to sensitive relay valves actuated by the pilot.

The hydraulic telecontrol system is not only capable of transmitting the pilot's motions to the control surfaces, but, being reversible, it also signals gust forces back to the pilot, thereby anticipating the impending change in the altitude of the ship while flying.



Mock-up of the instrument panel.

To safeguard the safety of the ship during flight, each control surface is operated by two completely independent self-contained and individually sufficient telecontrol systems supplied with electric power from separate generators. In case a failure of one of the hydraulic systems, the remaining one is completely capable of automatically taking over and operating the control surface under all conditions of flight.

The pilot's and copilot's flight controls in the cockpit are of conventional type with a column and wheel for the elevator and ailerons. The rudder pedals are made so they have a motion parallel to the floor, similar to the old-type rudder bar. This type worked out to be lighter and simpler than any other partly because there were no brake pedals to incorporate.

THE connection between the flight controls and the surfaces is the hydraulic system. The controls are connected directly to an hydraulic valve. This valve in turn operates another valve at the cylinder, which is fastened directly to the surface. There are cables, three-sixteenths of an inch in diameter, which act as follow-up cables maintaining the proper position relationship between the pilot's control and the only control surface.

The load that is required by the pilot to operate the surface is a portion of the pressure in the main cylinder. This load may be changed if required to get a heavier or lighter load feel. The trim tabs are operated electrically. Attached to the tabs are electric linear actuators which move the tabs.

Building the world's largest airplane of wood effected a considerable saving in engineering man-hours. This is largely due to the fact that it is easier to draw wood structure than metal. The experiments and developments in wood processes by the Hughes Aircraft Company have resulted in better quality workmanship than has ever before been attained in wood aircraft construction.

Large as the Hughes aircraft is it may be but the forerunner of aërial freighters with even greater range and capacity for tomorrow's skyways.

For Eminent Service We Salute—

James W. Lee, II, director of public relations, Chrysler Corp., Detroit, Mich. Membership Committee, Michigan Post, A.O.A.

William I. Ong, director of public relations, American Steel & Wire Co., Cleveland, Ohio. Membership Committee, Cleveland Post, A.O.A.

Frank J. Smith, president, John P. Smith Co., Rochester, N. Y. President, Rochester Post, A.O.A.

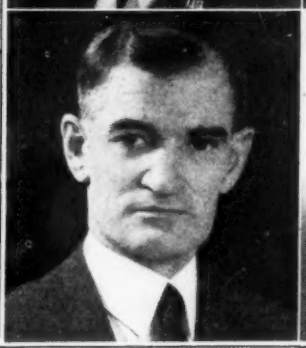
Brig. Gen. H. R. Kutz, chief, Training Service, Office of the Chief of Ordnance, Washington, D. C. Charter member, A.O.A.

Maj. Roland F. Wilson, U. S. Playing Card Co., Minneapolis, Minn. Secretary, Northwest Post, A.O.A.

Henry A. Winter, manager, Winter Weiss Co., Denver, Colo. President, Rocky Mountain Post, A.O.A.

Col. Richard W. Coward, assistant district chief, St. Louis Ordnance District, St. Louis, Mo. Southwest membership chairman, A.O.A.

Charles Pond, vice-president, Pratt & Whitney, West Hartford, Conn. Chairman, Gage Division Committee, A.O.A.



Dr. George C. Hale, powder and explosives expert, Picatinny Arsenal, Dover, N.J. Charter member, A.O.A.

R. S. F. DeMent, Red River Ordnance Depot, Texarkana, Tex. President, Red River Post, A.O.A.

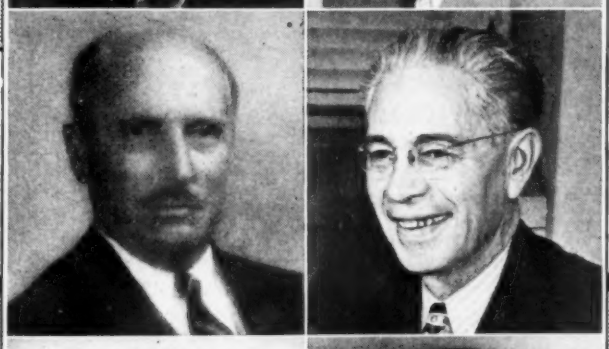
These Industry-Ordnance Leaders

Col. Charles McKnight, commanding officer, Casad Ordnance Depot, New Haven, Ind. Charter member, A.O.A.

Clyde Williams, director, Battelle Memorial Institute, Columbus, Ohio. Director, Cleveland Post, A.O.A.

Harry Erlicher, vice-president, General Electric Co., Schenectady, N. Y. Committee on Cooperation with Other Organizations, A.O.A.

Louis Polk, president, Sheffield Corp., Dayton, Ohio. Director, Cincinnati Post, A.O.A.

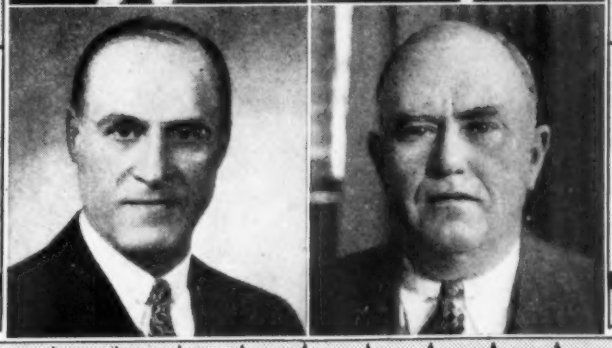


Dr. Henry B. Allen, director, Franklin Institute, Philadelphia, Pa. Adviser, Philadelphia Ordnance District.

W. F. Beasley, Research and Development Service, Office of the Chief of Ordnance, Washington, D. C. Charter member, A.O.A.

W. R. England, vice-president, Gulf Coast Furniture Manufacturing Co., Houston, Tex. President, Texas Post, A.O.A.

Robert F. Black, president, White Motor Co., Cleveland, Ohio. Director, Cleveland Post, A.O.A.

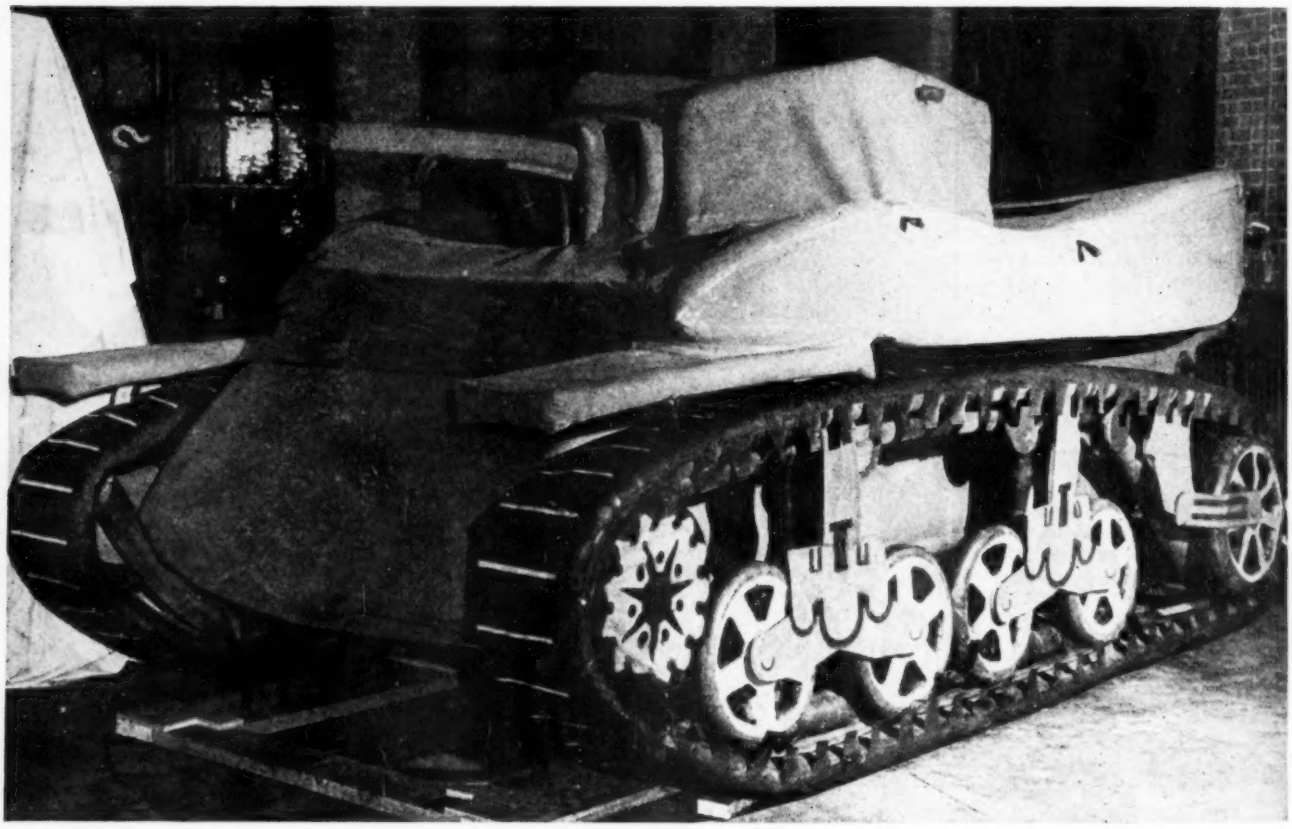


Albert J. Weatherhead, president, Weatherhead Co., Cleveland, Ohio. Committee on Coöperation with Other Organizations, A.O.A.

E. S. Dulin, president, Byron Jackson Co., Los Angeles, Calif. Member, Los Angeles Post, A.O.A.

Rubber Ordnance

Here is another of the "now-it-can-be-told" secrets of the war. The gun above and the tank below are just air and rubber. They were made to fool the enemy. From the air they could not be distinguished from the real thing, and they succeeded in drawing the fire of the enemy, thus playing a unique rôle in the strategy of victory (International News Photos).



Limitless War?

A Review of Fuller's "Armament and History"

Hoffman Nickerson

A NEW book by Maj. Gen. J. F. C. Fuller ("Armament and History," Charles Scribner's Sons, 1945) is always an event, and this one is no exception. Under armament it includes not only the specifically military tools known as weapons but also means of transportation and communication. Its subject is no less than the influence of all these military instruments upon society from the beginning of the classical period to the atomic bomb—which is treated in an epilogue.

The introduction points out the inevitability of war and at the same time its normal restriction throughout most of history as contrasted with the senseless destructiveness of certain past epochs and of our own. It adopts the classification of the periods of limited war—the Imperial Roman, the Medieval, and the Eighteenth Century—first, I believe, set down by the present reviewer, adding to them a fourth, the *Pax Britannica* from 1815 to 1914.

The first chapter discusses the many-sided effects of war upon inventiveness in accordance with the "Constant Tactical Factor." The second, "The Age of Valor," carries the story to Alaric's sack of Rome; the third, "The Age of Chivalry," to the fourteenth-century introduction of gunpowder. The late medieval and early modern period to the outbreak of the revolutionary era has a single chapter, "The Age of Gunpowder." Our own revolutionary era has three: "The Age of Steam," from the American Revolution to 1914; "The Age of Oil, Part I," from 1914 to the present time; and "The Age of Oil, Part II," a forecast of the immediate future.

Although the thesis is the importance of military material in the largest sense, Fuller would be the last to claim that superior armament alone must guarantee victory. Obviously many other factors enter in—numbers, courage and physical toughness, discipline, sound tactics, and above all, generalship. Between combatants approximately equal in material, these factors are decisive; but when one side is far more powerfully armed than the other the weakly armed side must possess a colossal superiority in other respects before it has a chance.

With their rifles and an occasional machine gun, late nineteenth-century British soldiers were usually able to defeat vastly superior numbers of Sudanese swordsmen or Zulus armed with assagais, in spite of the superlative courage of the latter. One is reminded of Belloc's couplet on colonial wars: "Whatever happens we have got the Maxim gun and they have not."

OF course the civilized troops would not have won had they been ideally perfect cowards, but at the same time material superiority diminishes the risks which its possessors must face. The author correctly insists that although "Napoleon was an infinitely greater general than Lord Raglan; yet Lord Raglan would, in 1855, have beaten any army which Napoleon could have led against him because Lord Raglan's men were armed with the Minié rifle. Eleven years after . . . Moltke would have beaten Lord Raglan's army hollow, not because he was a greater soldier . . . but because his men were armed with the [breech-loading] needle gun."

The point may be illustrated by the analogy of any of the simpler tools. For instance, the strongest man in the world cannot break or even bend a moderate-sized tree with his bare hands, whereas any able-bodied and reasonably adroit man can promptly fell the same tree with an ax.

Were we unhappily compelled to seek for faults instead of merits in so able a writer we might note that he understands the ancient and modern periods better than the Middle Ages whose realism and intelligence he underrates. In that connection it is a little disappointing to find him relying so much upon Professor Oman whose errors have been repeatedly exposed. Nor is the reviewer convinced that the *Pax Britannica* of 1815-1914 constituted a true limitation of war.

What was then the invincible British Navy could indeed have kept almost any conflict from spreading beyond the continent in which it originated but could hardly have prevented great continental struggles. In America, such a struggle did take place from 1861 to 1865. In Europe, France might have joined Austria and the smaller German states against Prussia and Italy in 1866, while Austria might have joined France against Prussia in 1870 for all England and her balance of power could have done to stop it.

Within a few years after 1870 all the Continental European powers had begun to arm to the teeth. By contrast, it is difficult to imagine a seriously destructive war within the Roman Empire, or medieval Christendom, or eighteenth-century Europe before the French Revolution. Such matters, however, are at most only evidence of the occasional fallibility of the chief living commentator upon war.

Returning to the main theme of the book, each new military instrument is the child of physical science and accumulated wealth, and is used in accordance with the organizing ability and the dominant motives of its time. Each new phase of armed competition usually differs both materially and morally from the preceding phase, results in an increase or decrease of command over material nature, and at the same time brings to the top a particular type of men as leaders.

Thus the wealth of the ancient world after Alexander's conquests made possible the multiplication and improvement of catapults until these last began to be useful not only in sieges but also as field artillery, while the comparative poverty of the Middle Ages made armor and war horses scarce enough to limit them to a military elite. Correspondingly, the weakening of medieval loyalties was accompanied by a sudden advance in physical science, of which

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Hoffman Nickerson has just written a stimulating and thought-provoking book—"Arms and Policy." He is a frequent contributor to these pages and is regarded as one of America's foremost military historians.

one product, gunpowder, altered not only military technique but also the social order by strengthening centralized governments against local sovereignities which had depended in part upon the strength of the comparatively small fortresses known as castles.

Fuller's sketch of the constantly accelerating pace of modern physical science recalls Henry Adams. Militarily the result has been a trend away from shock weapons and toward missile weapons of greater and greater range and power. Economically there has been a steady accretion of wealth. Politically this wealth has fallen more and more under the control of governments. Morally the quality of leadership has had its ups and downs.

The reasons for the irregularity of the "moral curve" we do not know. We must be content with Fuller to note the facts. The first modern phase is the horrible revolutionary chaos of the religious wars which, like all revolutionary eras, tended to bring violent and unscrupulous men to the top. After this, however, during the Age of Louis XIV and nearly all the eighteenth century, there was a rally. The ideas of moderation and of military honor brought back political stability and a form of war which systematically minimized injury to civilians. Armies were recruited from the very poor, officered by aristocrats, and disciplined to an extent never surpassed before or since. Meanwhile armament did not greatly change except for the substitution of the bayonet for the pike as the shock weapon of infantry, thus strengthening firepower.

Toward the end of the eighteenth century, new tendencies came to the surface: an explosive political theory of liberty and equality, together with extended governmental power, an increase in the importance of businessmen as compared with nobles, the beginnings of machine production, and improvements in missile weapons. An attempt was made to systematize the fierce popular passions by levies in mass and conscription laws which reduced men to cannon fodder. All the foregoing tendencies were stimulated by steam power.

Clausewitz masterfully worked out the theory of the nation at arms, while railways made possible the supply of ever larger armies. Railways plus steamships also began to unify the world economically, so that a prolonged war might impoverish the victor as well as the vanquished, but that point was missed in the furious national rivalries of the time.

Before 1800 field artillery was becoming more mobile and its projectiles more deadly. During the nineteenth century the flintlock smoothbore musket had become first a rifle which could be fired in any weather, then a breechloader, and finally a magazine rifle. Before 1900 the machine gun had appeared, while the fieldpiece had become a quick-firer.

BEFORE 1914 the internal-combustion engine, which was to usher in the age of oil, and the wireless telegraph, which was to make possible world-wide propaganda by radio, already existed. Nevertheless the war of 1914–1918 was begun with organizations and strategies which would have been more appropriate to Napoleon's day. When the reality of twentieth-century firepower drove the unarmored armies into trenches and dugouts, famine and revolution replaced generalship.

Two new mobile, oil-powered instruments, the plane and the tank, appeared, but neither was able to break the trench deadlock—although Fuller himself played a great part in working out tank tactics so effective as to foreshadow the lightning campaigns of twenty years later. With better support from British G.H.Q. the Cambrai battle of 1917 would have rolled up the whole German Western Front.

The climax of the book is its sulphurously eloquent but all-too-true analysis of the last war and the future toward which it seems to point. Miracles of technical inventiveness and of production have been accompanied by moral degradation as vile as it is stupid. The author justly notes of the baby-killing politely called "strategic bombing" that "As a speedy means of bringing the war to an end, bombing attacks on the enemy's industrial centers and civil population were a costly failure; for not only did they prolong the war, but they knocked the bottom out of eventual peace. . . . Instead of one coördinated offensive, two separate battles were fought—one on land with inadequate air power, the other against the enemy's cities with a superabundance."

Meanwhile outrages against prisoners kept pace with the massacres of civilians from the air. "Treaties are now scraps of paper; . . . Allies change sides . . . and the leaders of the opposing nations bawl at each other like fishwives, until war dissolves into a howling pandemonium in which every kind of atrocity is applauded when committed against the enemy and execrated when perpetrated by him."

In a society so irrational as to concentrate upon material productivity, in the century of the "common man" with his extremely common contempt for the disciplines of the spirit war alone can make consumption balance production. According to at least one highly educated man, the American and anti-Christian leftist Lewis Mumford, in our day war alone replaces self-seeking with heroism and sacrifice.

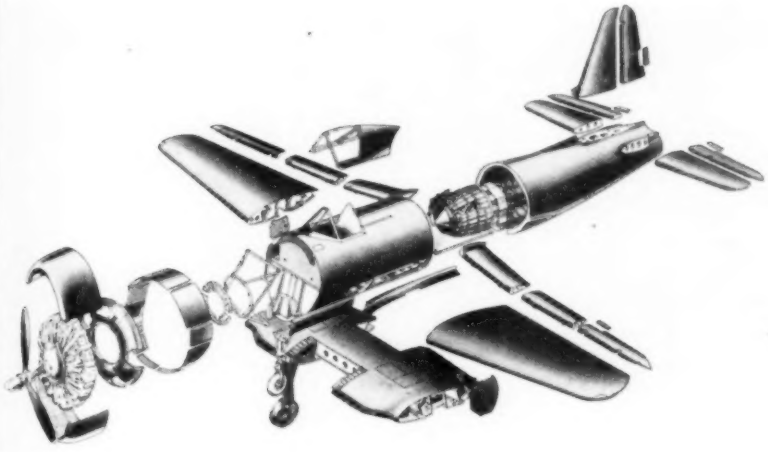
It is pleasant to end on a calmer note. After all, lifeless things like machines cannot compel the uses to which we may or may not put them any more than the possession of an ax can compel a man to fell one tree more than another, or indeed to fell any tree at all against his will.

Nor is Fuller shaken from his reasonable faith in the constant tactical factor —the perpetual swing of the pendulum between offense and defense—by the atomic bomb. Of atomic rocket bombs he writes: "Though their speed of flight is vastly greater than that of aircraft, by means of radio location it should not be beyond the wit of man to devise instruments and means of pin-pointing their spacial positions and destroying them by their like. Should this be feasible, it would appear that the decisive operations in future wars will be fought in the stratosphere, or even in pure space, between manless machines battling at altitudes beyond the range of sound and destroying each other without fear or pain."

As if to confirm this thought, as this article is written, *The New York Times* of January 14, 1946, carries an article on the high-frequency direction finder familiarly known to the armed services as "Huff-Duff" which was so useful against German submarines in the recent war and which, according to the newspaper, "if war comes again, may cope with an enemy's atomic bombs shot into space thousands of miles away."

New American Aircraft

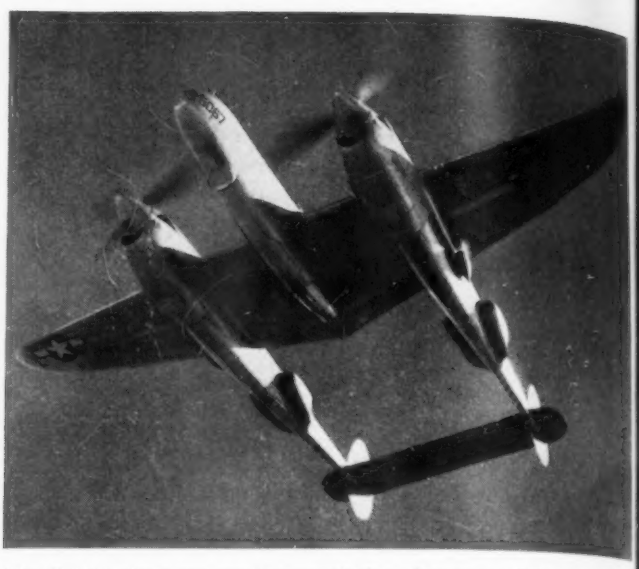
During World War II the demand for faster, longer-range aircraft with greater load capacity than ever before so stepped up the tempo of research and development that advances were made that would have taken years of normal effort to accomplish. Jet propulsion, rocket-assisted take-off, and new concepts of airplane size are but a few of the results brought about by the war. Many others are already commonplace while some will be reflected in civilian aircraft in the days to come. Many secret aircraft and devices not yet made public can only be guessed at, but the trend toward supersonic speeds and increased size is obvious. Some of the recent developments in civilian and military airplanes and equipment are shown on the following pages. Other newly revealed aërial weapons, American and German, are shown on pp. 187-192.



The Ryan FR-1 Fireball Navy fighter at right, above, combines jet engine in the tail with a conventional 1350-horsepower Wright Cyclone engine as shown in the diagram of the plane's component parts (Navy photos). The Army's XB-42 Mixmaster, right, has 2 hull-mounted counter-rotating propellers connected to twin Allison engines by long shafts (Army photo).

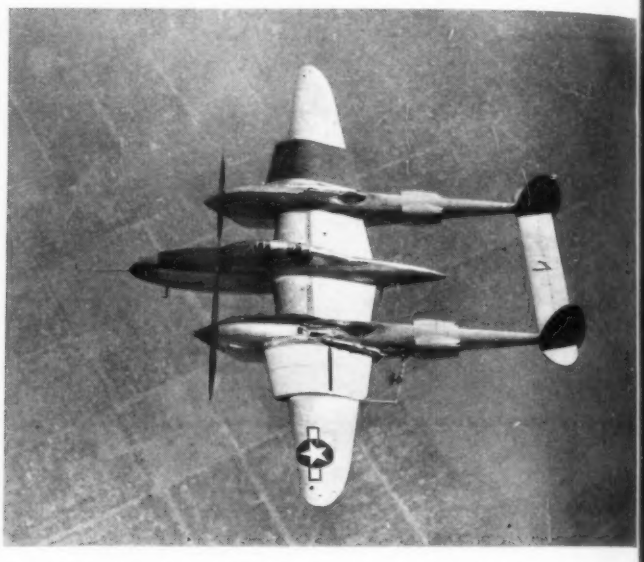
New Fighter Aircraft and Equipment

The Bell XP-83 long-range fighter and interceptor is powered by 2 GE I-40 jet engines which give it a speed of over 500 miles an hour.



The F-5-G photo-reconnaissance airplane known as "Photo Joe" is the P-38 with a special nose containing 5 powerful aërial cameras.

The 2-place Night Lightning was the fastest night fighter in World War II. It carried 4 caliber .50 machine guns and a 20-mm. cannon.

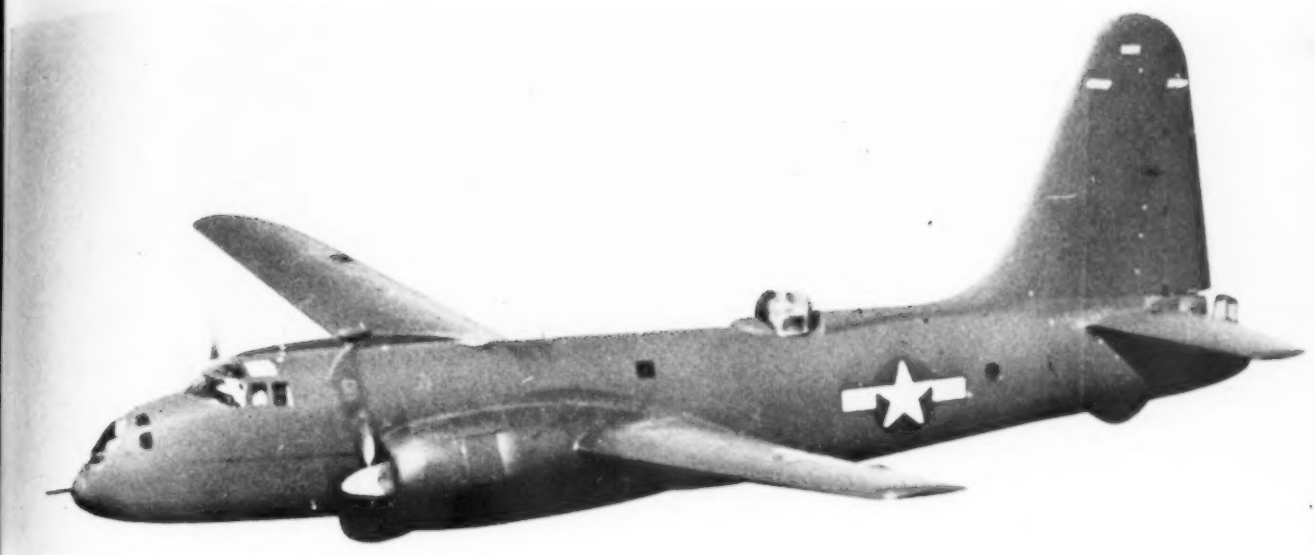


The Lightning Swordfish high-speed "flying wind tunnel" tested wing designs of superfighters and transports secretly since 1943.

Zero-type rocket launchers on the P-38 enabled it to fire fourteen 5-inch rockets with extreme accuracy singly or in salvo.

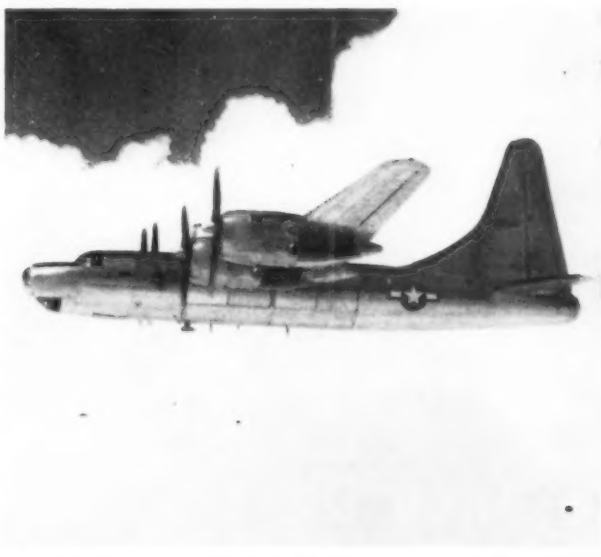
"Christmas tree" rocket launchers did not necessitate changes in wing structure as did the zero type and have been standardized.

Long-Range Bombers and Transports



The P2V, new Navy patrol and search bomber, has a range of over 5,000 miles, and it can carry 8,000 pounds of bombs and rockets. Armament consists of six 20-mm. cannon and twin caliber .50 machine guns mounted in the top and tail power turrets (Navy photo).

The Army's XB-36, shown in this artist's drawing, is now in process of assembly. It is a 6-engined pusher-type superbomber said by General Arnold to be larger and faster than the B-29 Superfortress (AAF photo).

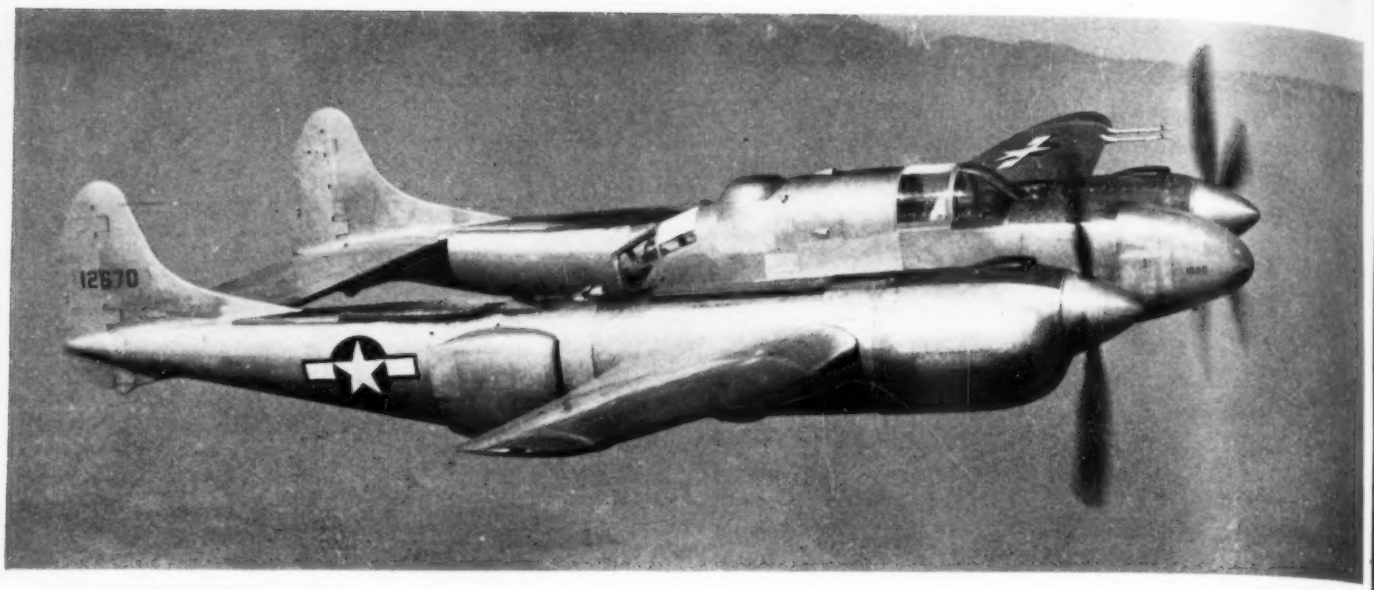


The B-32 Army heavy bomber features great firepower, large bomb load, long range, and a speed of over 300 m.p.h. It has a gross weight of about 100,000 pounds (AAF photo).

The Douglas C-74 Globemaster is equipped with its own loading elevator. It can carry 30 tons of cargo.

The C-74 can transport 125 troops 7,500 miles at speeds above 300 m.p.h. It is powered by 4 engines. Another view appears at top of p. 209.

Experimental Aircraft

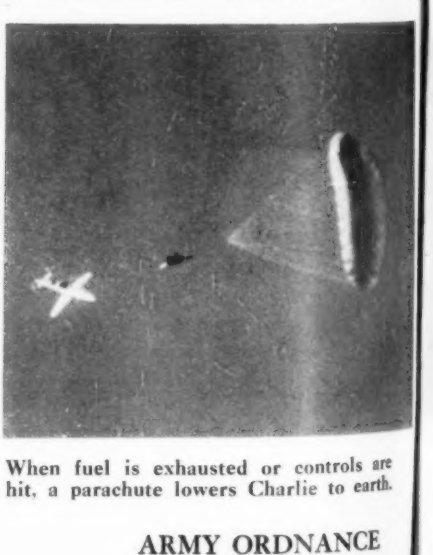


The XP-58 Chain Lightning 2-place experimental fighter and destroyer, above, had twin tail turrets and four 37-mm. nose guns. The Bell XP-77 all-wood fighter at right was once thought to be the answer to the Jap Zero, but its performance was not entirely satisfactory.

The XP-49, a major modification of the P-38 Lightning, had 2 special 1,540-horsepower supercharged Continental engines. It had a pressurized cockpit and low-pressure oxygen equipment. Top speed was 458 m.p.h. and loaded weight over 18,800 pounds.

Charlie Spars is a fast jet-powered target for aircraft and antiaircraft gunners.

"Charlie" is launched from a patrol plane and is then maneuvered by remote control.



When fuel is exhausted or controls are hit, a parachute lowers Charlie to earth.

A New Proposed Table of Storage Distances Revises the American Table

Col. Clark S. Robinson

IN the hundred years previous to 1910, there are records of 117 major accidental explosions of gunpowder, dynamite, nitroglycerin, and other similar explosives, totaling about 3,000,000 pounds and causing the known loss of life of 1,084 people. No adequate record is available as to the accompanying loss of property.

During that period there was no recognized rule or table which specified safe distances from stores of explosives. Because of this lack of regulation, large amounts of explosives could be and were collected and stored in close proximity to centers of population, and when they blew up, as explosives occasionally do, the nearby communities suffered.

In 1910, however, there was produced by a competent group connected with the explosives industry the American Table of Distances, which provided a rule for safety distances from explosives and which has served ever since as a basis for safety distance regulations for the armed services and for the explosives statutes of the several state governments. While there is no way of knowing what savings in lives and property have been accomplished by the general adoption of this table, there can be no doubt that it has amounted to thousands of lives and millions of dollars.

Since the table of distances was published in 1910, there have been a large number of additional accidental explosions for which reliable data are available. In 66 of these the combined explosives amounted to over 28,000,000 pounds, and 5,083 persons were reported killed. On the basis of the record before 1910, the computed expectation would have been 10,100 killed, a clear saving in lives of nearly 50 per cent which could well be attributed to the American Table of Distances.

However, the record is really better than this, because one of the 66 explosions was the terrible Halifax, N. S., disaster in 1917, where approximately 1,800 persons were killed due to the explosion of over 5,000,000 pounds of explosives on a ship in the harbor and where there was no attempt at protection whatsoever by the use of safety distances.

If this one explosion be omitted, the fatalities from the other 65 would have been 3,283, while on the pre-1910 basis 8,300 deaths would have been expected —a saving of 5,000 lives, or 60 per cent. Actually, on account of the greater strength or violence of our modern military high explosives, deaths in recent years might well have greatly exceeded computed expectations had it not been for the protection afforded by the table.

However, on account of the huge quantities of explosives handled during the past thirty years, particularly during the past five years, and also on account of the greater destructive power of these modern explosives, it has been thought advisable to survey all available information and to see if the American Table of Distances affords adequate protection according to present-day requirements.

This is particularly true since the greatest explosion listed in the preparation of the 1910 table was 800,000 pounds of black gunpowder, while in recent years many million pounds of modern high explosives have been accumulated at one place at one time with corresponding hazard to the surroundings.

The aim of the American Table of Distances was the protection of neighboring buildings and other structures from any damage due to a possible explosion, other than the breaking of window glass. This does not mean that the breaking of windows is not dangerous. In the Halifax explosion alone, 2,000 persons were partially or totally blinded by broken window glass. But the protection of buildings from glass breakage is beyond reasonable hope, windows having been broken from the Halifax disaster over sixty miles away, while from a black-powder explosion in Wisconsin in 1911 they were broken at a distance of eighty-five miles. The table aimed to prevent structural damage to dwellings and other buildings where people might be present by insuring sufficient distance between the explosion and these buildings.

In order to show how well the table would have protected structures from damage in the more important accidental explosions since 1910, a diagram, shown on p. 214, has been constructed. This diagram, on a special scale to permit the inclusion of a wide range of quantities, has on it two solid lines, a dashed line, and a large number of points indicated by crosses and circled crosses.

Each point represents an accidental explosion, the bottom scale showing the weight of explosives involved and the vertical scale the greatest distance at which structural damage other than broken windows was reported for the particular explosion. The circled crosses indicate that the damage was minor in character, the buildings not being rendered uninhabitable.

The two solid lines on the diagram are taken from the American Table of Distances. The upper line, marked "unbarricaded basis," shows the distance beyond which, according to the table, structures would be safe from the explosion of unbarricaded explosives, while the lower line was supposed to

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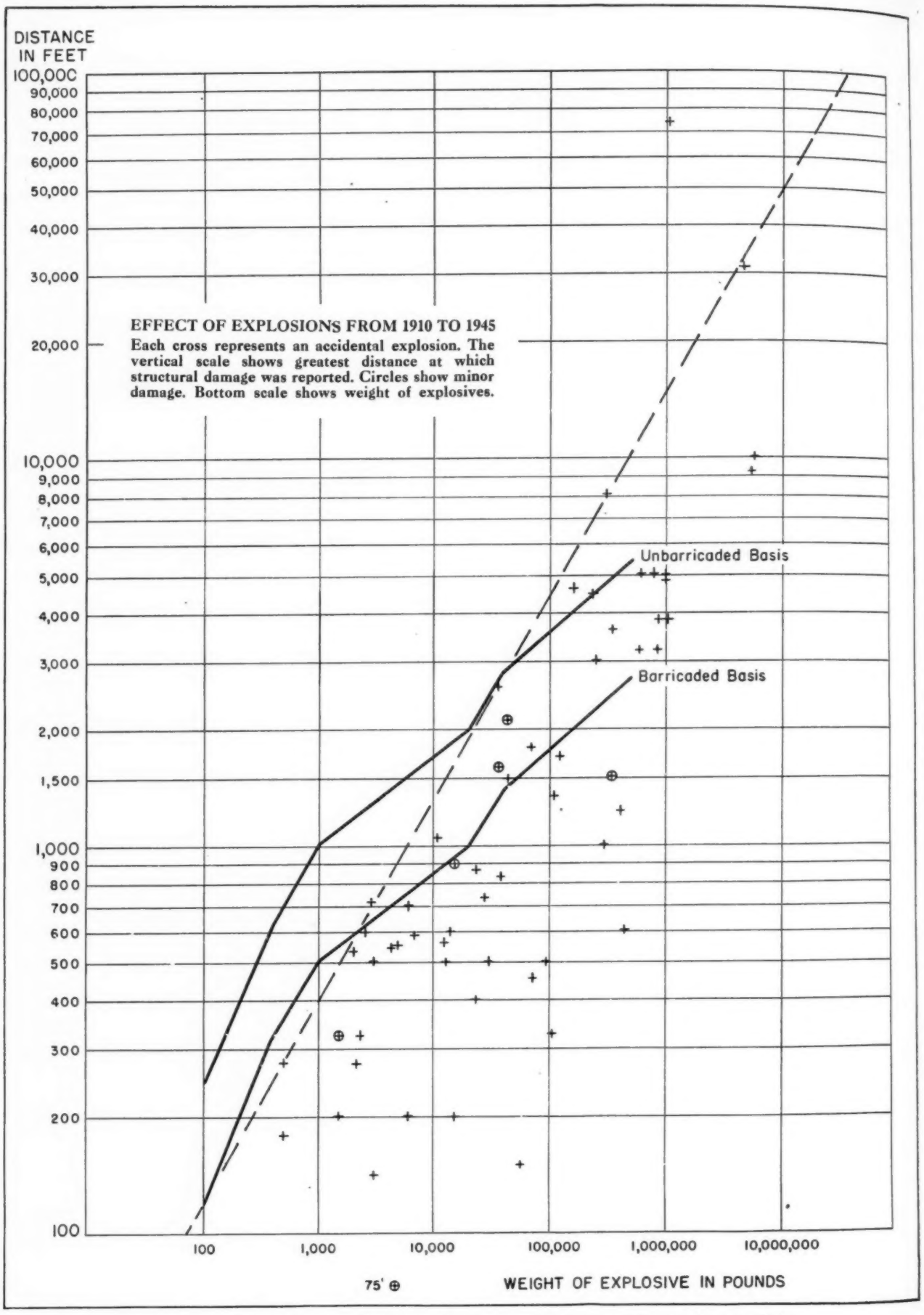
Colonel Robinson, on duty with the Army and Navy Explosives Safety Board during the past year and prior to that with the Ordnance Safety and Security Division, is professor of chemical engineering at the Massachusetts Institute of Technology on military leave.



How the American and proposed tables of distances would protect structures from explosions.

apply to barricaded explosions. This latter line was based on an assumption which was made in 1910 and which has since been shown to be without foundation. It can be neglected.

This diagram shows, taking one point for example, that the accidental explosion of slightly more than 10,000 pounds of explosives caused structural damage to a distance of a little more than 1,000 feet, while the table calls for a safety distance of about 1,700 feet. On the other hand, a point located at about 400,000 pounds shows a damage distance of 8,000 feet while the table shows the need for less than 5,000 feet.

Counting the points which lie on or above the "unbarricaded line" from the table, it is seen that there were 7 explosions, all of them greater than 100,000 pounds and extending in amount up to 5,500,000 pounds, for which the American Table of Distances would not have afforded protection. On the other hand, for quantities less than 10,000 pounds, the table shows about twice the necessary distance needed.

IN view, therefore, of the excessive distances required by the table for the smaller amounts of explosives and the inadequate requirements for the larger amounts, and particularly since the table only goes to 500,000 pounds, it appears advisable to offer a substitute table which will remedy these faults in the 1910 edition. This is offered in the proposed table on this page.

It will be noted that in this table no credit in the form of reduced distances is given for barricaded explosives, even though barricades may occasionally offer some protection.

The proposed safety distances given in the table are shown as the dash line in the diagram. It will be seen in the diagram that the only explosion in the category of very large amounts of explosives that would have been unprotected by these proposed distances is a point for the explosion of 1,100,000 pounds of high explosives which blew in the ends of flimsy airplane hangars at a distance of fourteen miles.

For details of the data on which this article is based, see the Army-Navy Explosives Safety Board Technical Paper No. 1, "The Present Status of the American Table of Distances," Washington, D. C., July 1, 1945. For complimentary copies, address: Army & Navy Explosives Safety Board, Washington 25, D. C.

PROPOSED TABLE OF SAFETY DISTANCES FOR EXPLOSIVES

Weight of Explosive (Pounds)	*Proposed Minimum Distance to Inhabited Buildings (Feet)*	*Equivalent Distance American Table of Distances (Feet)*
50	90	146
100	120	240
200	180	360
300	220	520
400	250	640
500	280	720
600	310	800
700	340	860
800	360	920
900	380	980
1,000	400	1,020
1,500	500	1,060
2,000	580	1,200
3,000	710	1,300
4,000	830	1,420
5,000	940	1,500
6,000	1,040	1,560
7,000	1,130	1,610
8,000	1,210	1,660
9,000	1,280	1,700
10,000	1,340	1,740
15,000	1,660	1,780
20,000	1,930	1,950
25,000	2,170	2,110
30,000	2,380	2,260
35,000	2,590	2,410
40,000	2,770	2,550
45,000	2,930	2,680
50,000	3,120	2,800
60,000	3,430	3,030
70,000	3,720	3,220
80,000	3,990	3,390
90,000	4,200	3,520
100,000	4,490	3,630
125,000	5,050	3,670
150,000	5,550	3,800
175,000	6,030	3,930
200,000	6,460	4,060
250,000	7,260	4,310
300,000	7,980	4,550
350,000	8,670	4,780
400,000	9,290	5,000
450,000	9,660	5,210
500,000	10,400	5,410
600,000	11,500	*End of*
700,000	12,500	*American*
800,000	13,400	*Table of*
900,000	14,200	*Distances*
1,000,000	15,000	.....
2,000,000	21,600	.....
3,000,000	26,700	.....
4,000,000	31,100	.....
5,000,000	35,000	.....
6,000,000	38,500	.....
7,000,000	41,800	.....
8,000,000	44,800	.....
9,000,000	47,700	.....
10,000,000	50,400	.....
15,000,000	62,200	.....

ORDNANCE ROLL OF HONOR

THE two following Ordnance officers have been awarded both the Distinguished Service Medal and the Legion of Merit:

MAJ. GEN. JULIAN S. HATCHER, Falls Church, Va., has been awarded the

General Hatcher

Colonel Raaen

Distinguished Service Medal for his work as chief of Field Service, Ordnance Department, during the 2½ most critical years of the war. During the period from February 1, 1943, to July 31, 1945, General Hatcher was responsible for storing, issuing, and maintaining all the vast output of the Nation's total production of cannon, small arms, and other weapons; tanks and combat vehicles; trucks and other general-purpose vehicles; spare parts of all kinds; bombs, explosives, and ammunition totaling over $30,000,000,000 in value.

General Hatcher was also awarded the Legion of Merit for his services as commanding general of the Ordnance Training Center at Aberdeen Proving Ground, Md., from January 1, 1940, to June 1, 1942, and as chief of the Military Training Division, Office of the Chief of Ordnance, from June 1, 1942, to February 1, 1943.

COL. JOHN C. RAAEN, Washington, D. C., was awarded the Distinguished Service Medal for performing exceptionally meritorious service in a duty of great responsibility as executive officer of the Office of the Chief of Ordnance from June 1942 to September 1945.

Colonel Raaen also received the Legion of Merit for displaying exceptionally meritorious conduct in the performance of outstanding services as chief of the Basic Chemical and Tank Branch, New Facilities Division, Industrial Service, Office of the Chief of Ordnance, from December 1941 to June 1942.

THE Ordnance officer listed below has been awarded the Distinguished Service Medal:

BRIG. GEN. JOHN K. CHRISTMAS, Washington, D. C.—For outstanding service in a duty of great responsibility as chief, Tank Division, Office of the Chief of Ordnance; as assistant chief and chief engineer; and as chief of Field Service operations of the Tank-Automotive Center (later Office, Chief of Ordnance-Detroit) of the Ordnance Department from June 1942 to October 1944. He contributed to and had a major interest in the design and production of the General Sherman medium tank M4.

THE following Ordnance officers have been awarded the Legion of Merit:

BRIG. GEN. DONALD ARMSTRONG, Washington, D. C.—For performing exceptionally meritorious service as commanding general of the Ordnance Replacement Training Center, later the Army Service Forces Training Center (Ordnance), Aberdeen Proving Ground, Md., from January 1943 to August 1944. General Armstrong completely reorganized the training center and brought it to its highest peak of efficiency. General Armstrong also received the Navy Legion of Merit for exceptionally meritorious conduct in the performance of outstanding services to the Government of the United States as commandant of the Army Industrial College (now Army-Navy Industrial College), from September 1, 1944, to November 30, 1945.

BRIG. GEN. NORMAN F. RAMSEY, New

Colonel Simon

Colonel Harris

York, N. Y.—For outstanding services as commanding general of the Rock Island Arsenal from December 1941 to May 1944 and as commanding general of the new Rock Island Ordnance Center from May 1944 to October 1944. He administered the affairs of this installation through the period of tremendous expansion following the outbreak of hostilities on December 7, 1941.

COL. WILLIAM I. WILSON, San Francisco, Calif.—For exceptionally meritorious conduct in the performance of outstanding duties as assistant chief of staff, G-4, XV Corps, from July 31 to September 29, 1944. Colonel Wilson also received the Bronze Star Medal as Ordnance Officer, Sixth Army Group, from February 20 to July 2, 1945, for meritorious service in the operations that carried the Seventh Army across

General Christmas

Colonel Hambleton

Colonel Bomar

General Armstrong

Colonel Wiman

Colonel McMahon

the Rhine, through Germany, and into Austria.

As Ordnance adviser to the First French Army, Colonel Wilson was appointed Chevalier, French Legion of Honor, and decorated with the French Croix de Guerre with palm "by a grateful Republic in recognition of services which aided in the liberation of France."

COL. ERNEST C. BOMAR, Washington, D. C.—For displaying exceptionally meritorious conduct in the performance of outstanding services from December 1941 to June 1942. He planned and executed changes in the methods of artillery case and shell production.

COL. JOHN S. COOKE, West Cornwall, Conn.—While serving successively in the Office of Chief of Ordnance and Headquarters of Army Service Forces from October 1941 to July 1945 he developed plans and control procedures for the allotment and distribution of scarce but vital matériel.

COL. HARRY B. HAMBLETON, Washington, D. C.—For displaying exceptionally meritorious conduct in the performance of outstanding services as chief of the Gage Section, Office of the Chief of Ordnance, from August 1941 to July 1943. He was responsible for the formulation of the basic program for engineering, production, and surveillance of Government inspection gages.

COL. JOHN P. HARRIS, Philadelphia, Pa.—For outstanding services in connection with procurement activities as chief of the Powder, Explosives, and Pyrotechnics Unit, Ammunition Branch, Ordnance Department, from June 1940 to October 1942. He prepared and executed plans for the facilities for production of powder and high explosives which were necessary to meet the war needs of the United States and to considerable extent the needs of other United Nations.

COL. FRED A. MCMAHON, Cincinnati, Ohio.—As deputy chief of the Cincinnati Ordnance Procurement District from September 1939 to July 1942 he demonstrated marked executive ability and leadership in administering the affairs of this procurement district. The able and efficient manner in which he organized an effective agency and administered the procurement of vast quantities of war materials constituted an outstanding contribution to the prosecution of the war effort.

Lieutenant Handler

Colonel White

Colonel Cooke

General Ramsey

COL. GROSVENOR F. POWELL, Washington, D. C.—For services while chief of Training Doctrine Branch, Military Plans and Training Service, Office of the Chief of Ordnance, during the period August 1942 to December 1944. During this period, he was responsible for the promulgation of doctrine for all training in Ordnance training establishments.

COL. LESLIE E. SIMON, Nashville, Tenn.—While serving as chief of the Ballistics Research Laboratory, Ordnance Research and Development Center, Aberdeen Proving Ground, Md., from April 7 to July 11, 1944, Colonel Simon headed a mission on ammunition calibration to the North African and European Theaters of Operation. The mission played an important part in providing ammunition of superior accuracy for the invasion of the Continent.

COL. HERBERT R. WHITE, Washington, D. C.—For rendering services of great value to the Chief of Ordnance from July 1940 to September 1945 first in the office of the assistant to the Chief of Industrial Service and later as special executive assistant to the Chief of Ordnance for industrial problems.

Major Otto

Colonel Wilson

COL. CHARLES D. WIMAN, Moline, Ill.—For rendering outstanding services as deputy chief, Tank and Motor Transport Division, Industrial Service, and later as special assistant to the Chief of the Control Division, Office of the Chief of Ordnance, during the period of June 1942 to January 1944.

MAJ. HENRY AVERY, Hanson, Mass. —Major Avery conducted field ballistic investigations regarding the rates of wear and expected life of artillery tubes and informed artillery commanders of means of increasing the accuracy of their firing.

MAJ. FREDERICK H. OTTO, Arlington, Va.—For service as assistant to the chief of the Legal Division, subsequently Contracts and Facilities Division, of the Office of the Under Secretary of War from December 1943 to September 1945.

FIRST LIEUT. HENRY HANDLER, Schenectady, N. Y.—While on duty at the Ordnance Research and Development Center, Aberdeen Proving Ground, Md., from November 1942 to April 1945, he displayed exceptional and meritorious conduct in the performance of duty.

Major Avery

Colonel Powell

German Explosives in Two Wars

The Enemy Had Planned Well for World War II

Dr. George C. Hale

THE production of military explosives in Germany during World War II had a much broader foundation with respect to raw materials than was the case in World War I. This was at least partly responsible for the fact that German ammunition did not show such a marked reduction in quality during the latter part of World War II as that which developed during 1917-1918. In order to indicate the action taken to avoid the difficulties encountered during World War I, a brief review of the situation at that time with respect to high explosives and propellants will be given.

Evidently the German procurement policy at the outbreak of World War I placed reliance solely on the coal-tar and atmospheric-nitrogen-fixation industries for the raw materials required to produce the bursting charges for shells and bombs, and on wood pulp, or wood cellulose, and glycerin to furnish the explosives necessary for production of propellants for all types of weapons.

It soon became evident that TNT, picric acid, and mixtures of TNT with ammonium nitrate, standard explosives in 1914, could not be made available in sufficient quantity to carry on the war, and various explosives derived from coal-tar products other than toluol and phenol were introduced in rapid succession. Trinitroanisole, dinitrobenzene, and mixtures of each of these with ammonium nitrate made their appearance in high-explosive shell early in 1915.

These were followed later by hexanitrodiphenylamine, trinitroxylene, hexanitrodiphenyl, trinitronaphthalene, and hexanitrodiphenyl sulfide, various mixtures of these explosives with oxidizing agents being used. Ammonium nitrate, potassium perchlorate, and lead nitrate were the common oxidants used to extend the tonnage of explosives beyond that available from the maximum possible production of the above nitro compounds which represented about all that could be produced in quantity from the various fractions of coal tar. These numerous nitro compounds could not be produced in sufficient quantity during the last year or more of the war since the requirements for high-explosive shell and bombs increased to such an extent that the high-explosive production program based on coal-tar derivatives became altogether inadequate.

At that time the ordinary blasting explosives or dynamites common in the field of commercial explosives were used extensively to load trench-mortar shell, grenades, and bombs—components which were subjected to little or no setback forces in their use. These explosives included Westphalit, Donarit, and other mixtures of ammonium nitrate with nitro compounds, wood meal, etc. Finally these mixtures had to be used in artillery shell.

THUS the Germans in World War I employed about ten different nitro aromatic compounds as base explosives, most of these being used with ammonium nitrate or other oxidizing agents to furnish a wide variety of mixtures as charges for high-explosive shell and bombs. These mixtures functioned fairly satisfactorily in so far as fragmentation effects were concerned, but the use of practically all except the original standard TNT, picric acid, and the amatols was attended with many difficulties.

The situation with respect to propellants was not as extreme as that which existed with high explosives. The propellants which were standard in 1914 were retained throughout the war, except that increased use was made of the older straight nitrocellulose powder designated R.P. '97 (tube powder of 1897) because of an insufficient amount of glycerin to produce the nitroglycerin required for their more modern propellants, R.P. '07 (tube powder of 1907), Blattchen Pulver (flake powder), and Wurfel Pulver (disk powder).

One change was introduced in the propellant R.P. '07, this involving the substitution of TNT for a part of the nitroglycerin used in manufacturing the powder. Owing to the shortage of fats in Germany the supply of glycerin had to be increased by the manufacture of synthetic glycerin, the so-called Protol process being used. It is understood this involved the fermentation of beet sugar, and the process was not highly regarded due to low yields and difficulty of obtaining glycerin of sufficient purity for the manufacture of nitroglycerin.

Germany's chemists learned well the lessons of World War I. The explosives they developed for the recent conflict were of high quality despite restrictions of raw materials.

However the manufacturing difficulties were overcome at whatever cost, for examination and study of German ammunition following World War I showed that, in general, the propellants used were well manufactured and of excellent quality. The only exception was the substitution toward the end of the war of the so-called Ammonpulver for a portion of the regular charge of R.P. '97 or R.P. '07 propellant.

AN extensive investigation of German ammunition captured during World War II has disclosed that in their preparation for this war the Germans altered somewhat their policy with regard to explosives procurement. While explosives derived from coal-tar constituents were still used in greater amount than those from any other source, these explosives were limited to TNT, tetryl, picric acid, dinitrobenzene, and hexanitrodiphenylamine. All of these, except dinitrobenzene, have generally favorable properties for military purposes, and none, with this one exception, was classed by the Germans as a substitute.

The use of dinitrobenzene, in spite of its extreme toxicity, was no doubt due to the fact that it has a favorable

Dr. Hale is chief chemist at Picatinny Arsenal, Dover, N. J.

melting point, about eighty-nine degrees Centigrade, which permits it to be used in molten condition as a carrier for solid materials such as ammonium nitrate, aluminum, etc., without exudation under any climatic conditions. Thus it appears that in World War II it was not necessary for the Germans to resort to the less-favorable explosives derivable from coal tar which were used so extensively in World War I; *e.g.*, trinitroxylol, trinitroanisole, trinitronaphthalene, hexanitrodiphenyl sulfide, and various mixtures comprising these explosives as major constituents.

DEVELOPMENTS in the field of aliphatic chemistry which occurred during the period of peace provided the wider source of raw materials required. Formaldehyde is produced from methanol which can be produced from coke. Formaldehyde reacts with ammonia to produce hexamethylenetetramine, which can be nitrated to yield cyclotrimethylenetrinitramine, an explosive having considerably higher brisance or fragmenting action than TNT or any of the other explosives derivable from coal tar. This explosive, often referred to as cyclonite in this country and designated Hexogen in Germany, is more readily susceptible to detonation by shock or friction than TNT, and it was employed by the Germans largely in mixtures with inert waxes or with TNT, the mixtures being so much less sensitive than the pure Hexogen that they could be pressed or cast into the ammunition component.

Thus Hexogen intimately incorporated with about ten per cent of its weight of Montan wax was used as a bursting charge for high-explosive shell from 20-mm. to 88-mm. in caliber and also as a booster charge for such shell. This explosive mixture was loaded by pressing methods since it cannot be melted at a practicable temperature for casting.

Other mixtures containing Hexogen in appreciable proportions were loaded by casting into shell of various calibers, in bombs, and rocket projectiles. These casting mixtures contained TNT or dinitrobenzene which could be melted at temperatures provided by low-pressure steam; and the Hexogen, with any other solid constituents such as aluminum, was carried in suspension when the mixtures were cast into the shell or other component. In some cases these mixtures also contained one to three per cent of wax as a desensitizing agent.

Another series of explosive compositions similar to those containing Hexogen was used, with PETN (or pentaerythrite tetranitrate) replacing the Hexogen. Thus PETN-wax mixtures were used as bursting charges in small-caliber shell and as booster charges for shell of practically all calibers. In fact these mixtures appear to have been used more extensively as booster charges than any other explosive, although boosters loaded with Hexogen-wax, tetryl, and picric acid, respectively, have been encountered in the examination of German ammunition.

Pentaerythrite, which upon nitration yields PETN, is produced by reacting formaldehyde with acetaldehyde in the presence of lime. Thus the explosive is not derived from coal tar but rather, like Hexogen, from compounds which can be produced from the more abundantly available basic materials, coal and air; *i.e.*, coke, oxygen, nitrogen, and hydrogen.

This broadening of the base from which their explosives were derived so as to include not only coal tar but the coal itself, together with the substantial capacity of the German chemical industry to produce ammonia and nitric acid from atmospheric nitrogen, enabled the Germans to complete the recent war without introducing, at least until the last few months of the conflict, numerous substitutes of inferior quality, as they did in World War I.

While reports indicate that explosives production was greatly reduced during the last months of the war by the allied bombing program and the problem of substitutes became urgent, production of ammunition components, other than explosives, was also reduced to such an extent that the capacity to produce ammunition as such, or ordnance matériel in general, probably did not exceed appreciably the capacity for production of the standard explosives.

A captured German report prepared for the Director of Explosives Supply and stamped "secret" lists the production rates for the various standard high explosives as of June 1943 and indicates the production rates planned ahead for June 1944. This is of interest in showing the relative quantities of the new and old explosives produced. (See the table above.)

	Production June 1943 Tons per Month	*Production Plan for June 1944 Tons per Month*
TNT	16,600	21,000
Hexogen	2,470	7,000
Picric Acid	280	400
PETN	820	1,400
Tetryl	16	30
Hexanitrodiphenylamine	650	950
Dinitrobenzene	1,380	5,000
Total	22,216	35,780

Secret German production schedule for both old and new high explosives.

These data show that the new explosives Hexogen and PETN constituted about fifteen per cent of the high-explosive compounds produced in 1943, and it was planned to increase the output of these to about twenty-five per cent of the total production by June 1944.

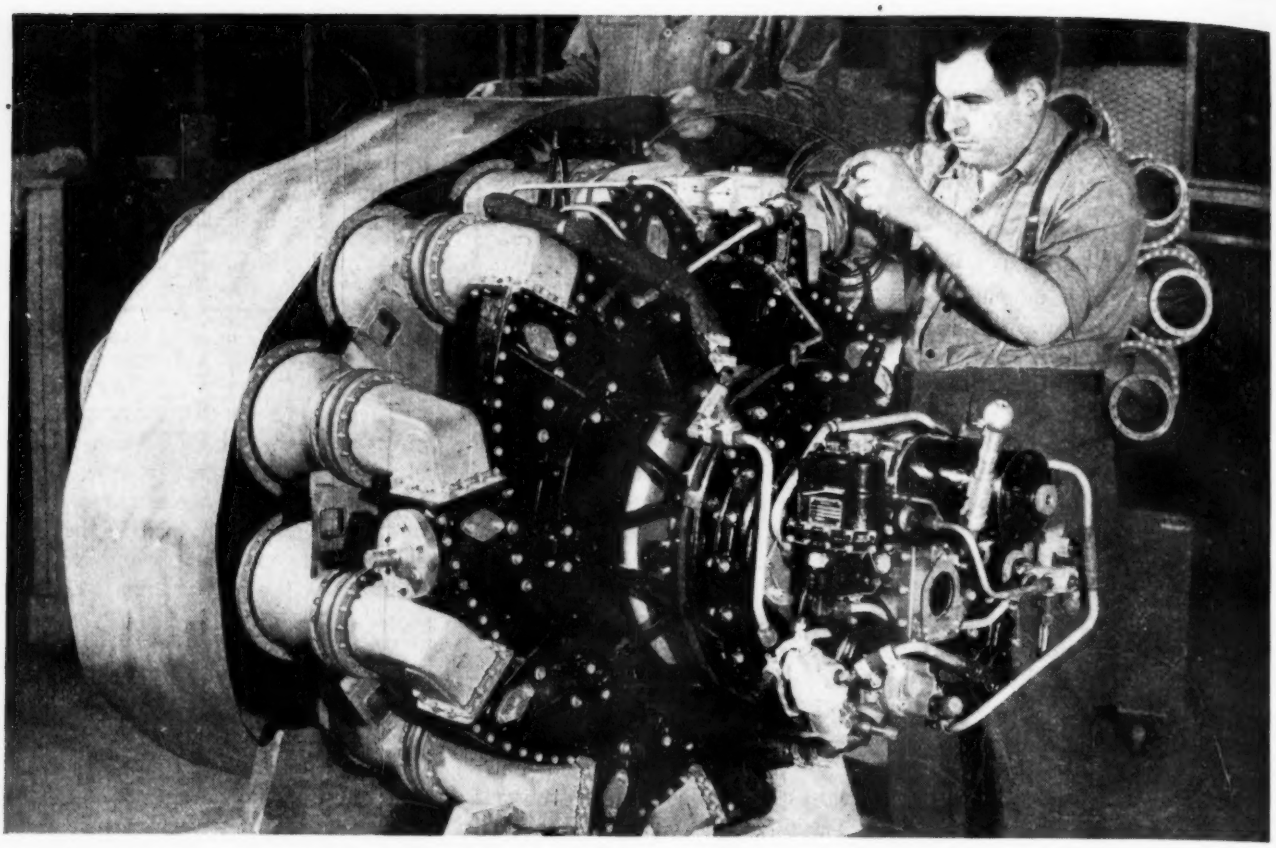
With regard to German propellants in World War II, there was also an apparent broadening of the base of supply as compared with World War I, since sole reliance was not placed on nitrocellulose and nitroglycerin.

Double-base powders were used generally for 37-mm. guns and most weapons of larger caliber, with nitroglycerin and diethyleneglycol dinitrate (DEGN) being employed respectively in both the tubular granulation of powder for various guns and in the flake or disk granulations for the various howitzers.

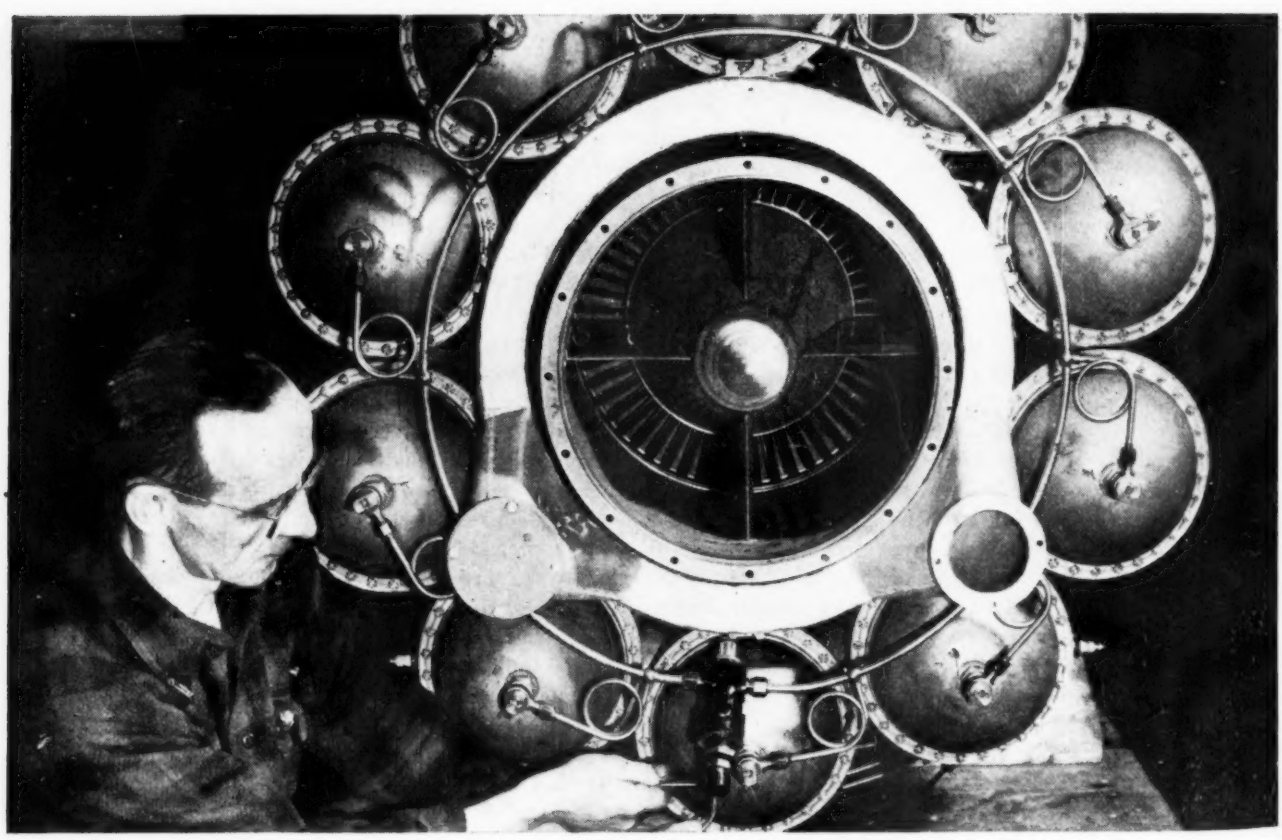
The introduction of powders containing DEGN, in lieu of nitroglycerin and of nitroguanidine as a partial replacement of nitrocellulose, is considered the major development in German artillery propellants between World Wars I and II, although other innovations of less importance, such as the use of PETN in a few small-arms powders, have been noted.

Thus it appears that the position of the Germans with respect to both high explosives and propellants during the greater part of the late war was greatly improved over that of World War I. This is true not so much because they had developed materials superior to those standard in World War I but rather because they had avoided the extensive use of inferior substitutes by standardizing prior to the war alternates which were well founded in their economy and were generally equal to, if not superior to, their oldest standard explosives.

The Jet Aircraft Engine



Workmen, above, make final adjustments on a G-E jet aircraft engine. The exhaust cone has been removed, below, to expose the blades of the gas turbine. This turbine, said to revolve at 10,000 r.p.m. with gases at 15,000 degrees F., is connected to an impeller compressor forming a single rotary part. Around the casing are the 10 circular combustion chambers in which the fuel burns.



ARMY ORDNANCE

Founded 1920

Combined with FIREPOWER, *the Ordnanceman's Journal*

Published Bimonthly by

THE ARMY ORDNANCE ASSOCIATION
WASHINGTON, D. C.

Col. J. L. Walsh, Founder and Editor, 1920-1922
Brig. Gen. R. H. Somers, Editor, 1922-1925
Maj. Gen. R. L. Maxwell, Editor, 1925-1926
Col. C. R. Baxter, Editor, 1926-1929
Col. Leo A. Codd, Editor, 1929-1942
Brig. Gen. R. H. Somers, Editor, 1942-1944

Editor: Leo A. Codd
Managing Editor: R. E. Lewis
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ARMY ORDNANCE, the journal of the Army Ordnance Association, has no official or semiofficial governmental status. All statements expressed in the articles, editorials, and advertisements are those of the authors, editors, and advertisers and do not represent official War Department policy.

MARCH-APRIL, 1946

Month by Month

General Campbell Joins Industry.—The transition of General Campbell from Chief of Ordnance of the Army to an important official of American industry—the other side of the team he has praised so highly throughout the war—is announced elsewhere in this issue. All members of the Army Ordnance Association will join in good wishes to one of industry's oldest friends and newest members.

Many times throughout the past four years and on frequent occasion throughout the twenty years preceding that, the name of Levin H. Campbell, Jr., has appeared in these pages. He first came to light here when he had the assignment, under the great Maj. Gen. C. C. Williams, of developing tanks for the very much skeletonized American Army.

In those days one Maj. George S. Patton was stationed at Fort Myer, Va., and was urging the development of fast, light, armored vehicles to bring back mobility to the battlefield after the stalemate of World War I.

It was the Patton influence that guided the Ordnance Department of those days in its striving for dependable, fast, and powerful tanks. Those were the times when Christie tanks were much in the public eye, and experiences of that era proved the wisdom of the Williams policy of military automotive development.

Levin Campbell was a part of that enterprise and left his mark upon it. Later on at Aberdeen Proving Ground and at Rock Island Arsenal he continued his efforts for modernized ordnance, and with consummate success. Turn to the pages of this journal during the late 'thirties, and we find him writing of an artillery production line—the first time a modern conveyer system and machine layout were applied to shell production in an Army arsenal.

From then on his record is much more popularly known. He began the planning and building of our great powder, explosives, and loading plants; then he undertook the direction of ordnance production; finally, in 1942, he became Chief of Ordnance for a term of four years to expire June 1, 1946.

With his retirement the Ordnance forces give to American industry one of their most colorful and dynamic personalities. There is cause for real happiness that American industry thus takes into its councils one who after more than thirty-five years of Army service can translate to industry the military needs as we go on through a period of peace.

As this issue of ARMY ORDNANCE goes to press, word is received that the President has sent to the Senate nominations of the following Ordnance officers: To be Chief of Ordnance, Maj. Gen. Everett S. Hughes, formerly a member of General Eisenhower's staff overseas and Inspector General of the European Theater of Operations in recent months; to be assistants to the Chief of Ordnance, Maj. Gen. G. M. Barnes, who has been in charge of Ordnance research and development, and Maj. Gen. Henry B. Sayler, who was Chief Ordnance Officer in the European Theater of Operations. All are career Ordnance officers of outstanding attainments.

To them the Army Ordnance Association pledges its best coöperation in their difficult assignments. American Ordnance must make tremendous advancements, especially during the four years ahead. The atomic age demands points of view, energies, and determinations which will keep our fighting forces adequately equipped. Atomic energy and electronics are fast changing the shape of our national-defense structure. These men, with the help of American science and industry, have a gigantic job to do for our national survival.

Service Reorganization.—What may be the forerunner of the streamlined form of our fighting services is indicated by steps recently taken by Fleet Adm. Chester W. Nimitz for the reorganization of the Navy Department. The new Chief of Naval Operations has done away with the unwieldy bureau organization and has replaced it with six deputy chiefs to keep him in touch with all branches of the Navy. These are deputy chiefs for personnel, administration, operations, logistics, air, and special weapons.

The deputy chief for administration has supervision of controls, intelligence, communications, island governments, and naval missions to various countries. The deputy chief for logistics supervises supply and procurement and the transportation of personnel and matériel. One of the most important of the six deputies is the office held by Vice Adm. W. H. P. Blandy, formerly Chief of the Bureau of Ordnance. He is in charge of the supervision of development of new weapons, including the forthcoming experiments with the atomic bomb on naval vessels. In addition there is a Matériel Division and a Naval Inspector General. So much for the reorganization within the Department itself.

At sea, provision is made for three fleets in the Atlantic,

three in the Pacific, and one in European and Mediterranean waters. The Atlantic Fleet will include the Fourth, Eighth, and Tenth Fleets. The Eighth, embodying a small carrier element, will base in home waters and will operate normally in the North Atlantic and Caribbean. The Tenth, consisting of cruisers and destroyers, will operate in the Caribbean and South Atlantic. The Fourth will constitute the Atlantic Reserve Fleet and will be used for the training of reserves off the coast.

The Pacific Fleet will base at Pearl Harbor and will have three components. The Third Fleet will be in the Pacific reserve and will be charged with reserve training off that coast. The Fifth will operate in the Central and Eastern Pacific, and the Seventh will operate in the Western Pacific. The Twelfth Fleet will consist of ships required in European and Mediterranean waters.

This organization of the Navy may be a forerunner of our interim Army until such time as a clear-cut national-defense policy for the Ground and Air Forces is determined upon. General Eisenhower has already indicated to Congress that the interim Army of 1,500,000 men is the minimum estimate by responsible commanders of the numbers necessary to meet our needs. These will enable the Army to discharge the colossal task of occupying, policing, emergency relief and rehabilitation, collecting and guarding our huge overseas supplies, training and shipping replacement personnel, and the housekeeping overhead of the establishment itself.

But this is an emergency organization. The Army eagerly awaits the Eisenhower pattern of peacetime organization along the lines of the Nimitz modifications of the Navy. It seems certain that there will be, under the General Staff as at present constituted, the three main divisions of the Ground, Air, and Service Forces. This is a natural and logical division unless and until the air arm is given separate entity. The Eisenhower method of doing things emphasizes coöperation not only with outside agencies but among agencies within the Army.

It is to be hoped that the technical services of the Army will emerge again to their rightful place of importance. For four long years they were submerged under the Army Service Forces headquarters which tied them tight in red tape with its monstrous delays, wastes, and foibles.

We will not have maximum efficiency and economy together with the best weapons in sufficient quantity until the maker and the user in our Army are brought closer together. Intermediary experts only delay and waste our military and industrial effort. It would seem that the Navy has found a way to cut the red tape in the new Nimitz organization. It will be a gala day for the Army when the Eisenhower plan, yet to be announced, does likewise for the Army.

The Guard.—The National Guard plans to return to its prewar status with 600,000 officers and men—three times the size of the pre-Pearl Harbor militia. It anticipates the strength of the Regular Army eventually tapering down to 350,000 men. The postwar mission of the Guard, as publicized in a revised memorandum of October 1945, follows:

To provide a reserve component of the Army of the United States capable of immediate expansion to war strength, able to furnish units fit for service anywhere in the world, trained and equipped to (1) defend critical areas of the United States against land, sea-borne, or air-borne invasion; (2) to assist in covering the mobilization and concentration of the remainder of the reserve forces; and (3) to participate by units in all types of operations, including offensive, either in the United States or overseas.

Present plans include a National Guard Air Force of about 50,000 men and 3,000 airplanes. This is an element of the Guard which assumes growing importance. National Guard fliers provided experienced combat pilots early in World War II. There seem to be many good reasons why our aviation forces in the Guard should be built to include many airborne divisions which will require a particular type of training of younger men for this all-important duty.

Whatever the form of our postwar military organization, the National Guard will hold important place, second only to that of the professional army. No component of our forces displayed greater heroism or military skill in all our battles from 1941 to 1945. On its record the Guard has merited a stronger and more influential place in the national-defense structure than it has ever had before.

Two Great Records.—A recent report of the Surplus Property Administration is devoted to chemical plants and facilities. Primarily intended to chart the way for effective utilization of surplus ordnance plants, it is itself an historic accounting of the construction and operation of these huge manufactories. This study was one of the last official acts of W. Stuart Symington, as Administrator of Surplus Property, before he assumed his new duties as Assistant Secretary of War for Air.

He took an active part in the ordnance production program when it was at its height. His interest in ordnance progress has continued on so that his appointment to the War Department post augurs well for the continuation of progressive policy. We call attention to this report because of its value not only to current surplus property disposal policies but also to the record of the war which will be studied in years to come. Already it is growingly apparent that detailed records of what was done and how will assume greater and greater importance.

Thus the Engel report, published by the Army Ordnance Association last year (Army Ordnance Report No. 6, dated August 21, 1944), stands for all time as a record of the efficiency and economy which governed the operation of huge ordnance production by American industry in Government-owned plants. The magnificent things done by industry in the war does not surpass the achievement in the operation of these Ordnance plants.

The Engel report, supplemented by Mr. Symington's analysis, comprises the printed story of this vast operation. Both documents reflect great credit upon management and labor of our larger operating concerns. They also show that with the proper understanding on the part of Government, management and labor can combine to do a wartime job under a system of free enterprise which gives to our democracy its basic strength. Free enterprise is of the essence of America. All that we have has grown from this priceless possession.

As years go by, the Engel report and the Symington report will stand to refute the challenge of those who claim that there are better means of life and of survival than the time-tested American way.

Mineral Depletion

An Editorial

SECOND only to the loss of human life by our American forces in World War II was the tragic cost of that conflict in our mineral wealth. By reason of the mammoth drain on our major minerals during the war years there are only nine of which we have a supply estimated to last a hundred years. Twenty-two essential minerals have dwindled to a 35-year supply.

¶ The cost of the war in minerals and fuels reached the staggering total of $36,000,000,000. These were poured into the manufacture and operation of guns, ammunition, tanks, ships, airplanes, and the maintenance of the civilian economy for ourselves and our allies.

¶ During the war years our consumption of these priceless commodities was equal to twenty per cent of the total value of all minerals and fuels produced in the United States during the 65-year period from 1880 to 1945. Of our war production, $11,002,000,500 went for metals, $20,748,300,000 for fuel products, and $4,840,400,000 for nonmetallic minerals.

¶ These startling results of our magnanimous war policy of supplying the United Nations and ourselves without stint or limit should give us pause. Our national strength has been weakened beyond reclaim. Our normal civilian consumption will soon exhaust the presently known supplies. Meanwhile, other nations of the earth are seizing and holding vast accumulations of these essentials.

¶ Steps should be taken without delay first to assure that our national defense is not further jeopardized and secondly to make compulsory a type of military planning which will not permit the unconscionable waste of these products in time of war. The military mind as well as the industrial mind must be taught that waste in peace or in war is a calamity of the first order. Our potential for national security is already weakened to the point where national survival is threatened. Our ultracharitable statesmen should bear this in mind for it is of the essence of the common defense.

Association Affairs

GENERAL CROWELL HONORED: Association President Receives Williams Medal

Brig. Gen. Benedict Crowell is to receive the Williams Gold Medal for Distinguished Ordnance Service—the highest honor of the Army Ordnance Association. At their special meeting in November 1945 the directors of the Association unanimously awarded the medal to General Crowell in tribute to his outstanding service to the Nation and to the Army during the past twenty-five years. The occasion for the presentation of the medal will be announced later.

Early in World War I, General Crowell, with the rank of major, began his service to the Army. At the peak of that emergency he assumed the office of the Assistant Secretary of War and Director of Munitions under that great citizen and leader, Newton D. Baker.

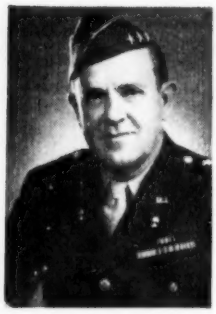
When the Army Ordnance Association was formed in 1919, General Crowell became its first president, an office he filled with distinction during the following twenty-five years. The record of the organization throughout that period is a tribute to his leadership and ability. When Henry L. Stimson became Secretary of War in 1940, one of his first acts was to request General Crowell to serve as a special consultant.

For the next four years General Crowell made weekly trips to Washington to consult and advise with War Department officials on the conduct of the war. He has now returned to his civilian post as chairman of the finance committee of the Central National Bank of Cleveland.

All members of the Association will join in grateful tribute to a gallant gentleman who, through two world wars and through all the years between, gave freely of his time and talents to the advancement of industrial preparedness and to victory.

SWORDS TO PLOWSHARES: General Campbell Joins International Harvester Company

The man who rallied American industry to its gigantic production job in World War II has changed his position on the team. Lieut. Gen. Levin H. Campbell, Jr., Chief of Ordnance since June 1, 1942, retired from active military service February 13, 1946. On March 1st he became vice-president of International Harvester Company in Chicago, coördinating a program of new plant construction. Throughout these pages over many years, the name of Levin Campbell has appeared. In 1944 he was awarded the Association's Crozier Gold Medal for distinguished ordnance service. In this issue he presents a message to all members of the Army Ordnance Association on page 178. We would like to add, in addition to the editorial expressions on page 221, these salient facts in his long and distinguished military career:



General Campbell

A native of Washington, D. C., and graduated from the United States Naval Academy in 1909, General Campbell entered the Army December 2, 1911, as a second lieutenant in the Coast Artillery Corps. He was assigned to the Office of the Chief of Ordnance in April 1918 and, during World War I, was engaged in the engineering development of self-propelled mounts and Ordnance automotive vehicles.

After service in various Ordnance installations, General Campbell was ordered to Washington, D. C., in 1926 to take charge of the automotive section, Artillery Division, Office of the Chief of Ordnance. He was later officer in charge of manufacture at the Rock Island Arsenal, Ill., and then in charge of the Artillery Ammunition Department at Frankford Arsenal, Philadelphia. Returning to Washington, he became assistant chief of Industrial Service Facilities and October 1, 1940, was placed in charge of Development of Facilities, Office of the Chief of Ordnance.

Since February 1945 General Campbell has been a member of the executive committee of the Research Board for National Security. Since August 1945 he has been assigned to the Office of Reconversion in Washington, D. C.

For his outstanding services as Chief of Ordnance, General Campbell was awarded an Oak Leaf Cluster to the Distinguished Service Medal awarded him for his work as chief of Development of Facilities.

EXECUTIVE COMMITTEE: Association Group Studies Revision of By-Laws

The executive committee of the board of directors of the Army Ordnance Association met at the University Club, New York City, January 25, 1946, for the consideration of the proposed constitution and by-laws as published elsewhere in this issue. The draft, as submitted by Col. Herbert A. Gidney, chairman of the Committee on Aims and Organization, required several slight modifications due to conditions which arose after the draft report had been approved by the directors at their meeting last November.

Principal among these was a change in the laws of the District of Columbia, under which the Army Ordnance Association is incorporated, which change relates to a quorum of directors for the transaction of business. Another modification, on recommendation of the counsel, relates to the freedom from liability of officers and directors for acts of the Association. These and other revisions are included in the draft published on pages 197 through 200 of this issue.

Present at the meeting of the committee were: Col. Frederick H. Payne, vice-president; Brig. Gen. John Ross Delafield, counsel; Col. James L. Walsh, director; Col. Henry P. Erwin, assistant treasurer; and Col. L. A. Codd, executive vice-president and secretary.

A resolution in tribute to the late Brig. Gen. Charles Elliot Warren, treasurer of the Association, was presented by Colonel Walsh and spread upon the minutes. The resolution is published in full on p. 227. An obituary of General Warren appears on that page. The following resolutions were also adopted:

"Whereas Col. Henry P. Erwin, a charter member of the Association and one of its founders, has served as assistant treasurer for the past three years, and

"Whereas he has shown on innumerable occasions his interest in the welfare of the Association and his willingness to assist it through his counsel and advice as financier, educator, Ordnance officer, and citizen, be it

"Resolved that Colonel Erwin be appointed treasurer of the Association with full power of that office as prescribed in the by-laws."

"Whereas the Committee on Aims and Organization, in its report presented to the board of directors at their meeting on November 28, 1945, submitted a draft of a proposed constitu-

tion and by-laws which were approved by the board, and

"Whereas on November 30, 1945, the President of the United States approved an amendment to the Code of Laws of the District of Columbia which authorized any corporation formed under authority of subchapter 3 of Chapter 18 of such code to specify in its by-laws that a less number than a majority of its trustees may constitute a quorum for the transaction of the business of the corporation, and

"Whereas counsel of the Association has recommended several minor changes in the text of the draft to be made before submitting it to the members of the Association for approval, be it

"*Resolved* that the executive committee, on behalf of the board of directors, approve the revisions of the committee draft as recommended by counsel."

The committee also approved a budget of expected receipts and proposed expenditures for the year 1946. It also discussed the title and content of *Army Ordnance Bulletin*. The new title will be *Industrial Preparedness* inasmuch as its editorial content relates to this general subject. Reports of the secretary and treasurer which were presented in brief will be submitted in full at the annual meeting of the board of directors to be held in April.

SAN FRANCISCO: Four Directors Are Added to the Roster of the Post

Four new directors have been added to the roster of the San Francisco Post. ARMY ORDNANCE extends a hearty welcome to these distinguished citizens of the West Coast:

Dr. Robert G. Sproul, president, University of California; W. A. Starr, vice-president and chairman of the board of directors, Soundview Pulp Company, San Francisco, chairman of the executive committee and director, Central Bank, Oakland; S. D. Bechtel, president, W. A. Bechtel Company, contractors, San Francisco, chairman of the board of directors, California Shipbuilding Corporation; and R. M. Alvord, commercial vice-president, General Electric Company, San Francisco.

NORTHWEST POST: General Sayler Tells of Ordnance Supply at the Annual Meeting

Maj. Gen. Henry B. Sayler, Deputy Chief of Ordnance, described for the members of the Northwest Post, Army Ordnance Association, what it means logistically to supply fighting equipment for the battlefields of the greatest war in history. This was the subject of his address at the annual meeting and banquet of the Post held at the Hotel Radisson, Minneapolis, Minn., December 17, 1945. The movie, "Firepower Pays Off," was a fitting climax to the general's inspiring account of ordnance in action in Europe.

General Sayler

Another high light of the program was the inimitable toastmastership of Brig. Gen. Harold E. Wood of the Minnesota State forces, and president of the National Guard Association of the United States. His performance, as parliamentarian, was on a par with General Sayler's as logistician. The 320 members and guests present took great delight in both.

Luther S. Oakes, president of the Post, conducted the business meeting following the invocation of Chaplain A. P. Klausler of Fort Snelling. Greetings were extended by Governor Thye of Minnesota, and current operations of the Chicago Ordnance District were described by Col. John Slezak, district chief. Walter G. Seeger, St. Paul, was chosen to succeed Mr. Oakes as president of the Post.

In keeping with all other meetings of the Northwest Post, this one was an outstanding example of organization and coöperation. A number of committees were actively in operation under the following chairmen: General, Harry A. Bullis; Nominating, Brison Wood; Publicity, Gideon Seymour; Transportation, Maj. Arnold J. Beyer; Hospitality, Maj. Roland F. Wilson; and Attendance: Minneapolis, Fred Blumers; St. Paul, Mr. Seeger; Duluth, Alex Chisholm; Southern Minnesota, W. F. Kasper; South Dakota, George Rozum; North Dakota, Don Smith.

Once again Col. A. V. Stallard, chief of the Twin Cities Ordnance Region, and Major Wilson, secretary-treasurer of the Post, gave yeoman service in organizing the meeting and carrying it to such a successful conclusion.

MICHIGAN: Admiral Mitscher Answers $64-Question with A.O.A. Bulletin

With a Detroit Baseball Club cap jauntily worn at a rakish angle, Vice Adm. Marc A. Mitscher stood before an overflow audience (more than 800 members and guests) of the Michigan Post of the Army Ordnance Association, answered questions about naval operations in the Pacific, and spellbound his hearers. This took place at the semiannual meeting of the Michigan Post at the Book-Cadillac Hotel, Detroit, Mich., on December 11, 1945. The admiral's address is on p. 179 of this issue of ARMY ORDNANCE. The question period took a neat turn when the great naval warrior was asked about the merger of the Army and Navy. He called it the "$64-question" and answered by quoting a paragraph from *Army Ordnance Bulletin* of November 15, 1945. That took the house by storm!

Admiral Mitscher

At this meeting Army Ordnance Association Gold Emblems were presented to the following men for their part in the phenomenal growth in membership of the Michigan Post: Brig. Gen. A. B. Quinton, Jr., chief of the Detroit Ordnance District; K. T. Keller, president, Chrysler Corporation; Prentiss M. Brown, president, Detroit Edison Company; O. E. Hunt, vice-president, General Motors Corporation; Edward T. Gusheé, president, Michigan Post; Robert L. Biggers, president, Fargo Division, Chrysler Corporation; and John E. Johnson, public relations director, General Motors Corporation.

A goodly representation of industrial and civic leaders of Michigan was present at the speakers' table. Mr. Biggers, chairman of the Post's committee on meetings, was toastmaster. His introduction of Admiral Mitscher was acclaimed for its beauty of expression and its tribute to a great fighting man of the American forces. It was particularly appropriate as showing the fine spirit of coöperation which has always existed between the Navy in all its branches and the Ordnance Department of the Army.

The committee in charge of the meeting, in addition to Mr. Gusheé and Mr. Biggers, had the always-efficient assistance of Lieut. Col. J. W. Paynter, secretary-treasurer of the Post, and Clifford A. Mogk and Miss R. Moran, assistant secretaries.

GOOD WISHES, FRANK: Colonel Atwood Joins Remington Rand, Inc.

Col. Frank J. Atwood, for the past 3½ years chief of the Rochester Ordnance District and secretary of the Empire Post, A.O.A., has been named director of purchases for Remington Rand, Inc., and its subsidiary companies. Colonel Atwood has just retired from active Army service after having been a commissioned officer in the United States Army since 1916. Born in Bradford County, Pa., he was graduated from Washington State College and the University of Michigan, continuing his education with graduate work at the University of Michigan and at the Massachusetts Institute of Technology.

Colonel Atwood was commissioned a second lieutenant in the Coast Artillery Corps in 1916, served in France as an artillery officer during World War I and later with the Army of Occupation in Germany. Upon his return from foreign service he was assigned to the Ordnance Department after receiving special training. He has served on the staff of the Assistant Secretary

of War and the staffs of two commanding generals as well as on the staff of the Chief of Ordnance. He is a graduate of the Army War College and the Army Industrial College and has been an instructor in the latter.

Colonel Atwood's broad Army experience earned him the important assignment, in June 1942, as chief of the Rochester Ordnance District. In this capacity he was responsible for the development, purchase, production, inspection, and shipping of war materials measured in terms of billions of dollars.

ST. LOUIS: "Double Features" Prove Big Attraction in District Area

The St. Louis Ordnance area is setting a new pace when it comes to Army Ordnance Association business. It really is doing double-quick time to see that its eight A.O.A. Posts maintain the membership strength and active interest in industrial preparedness in the forthcoming years that they have built up during the war. Since V-E Day, within the St. Louis Ordnance District there have been on two occasions two A.O.A. Post meetings on two consecutive days!

General Barnes

One reason for arranging meetings on consecutive days is that in so doing it is possible to obtain one outstanding speaker for both meetings and, due to the geographical size of the district, save time and travel expense for the out-of-town guests.

Starting with the two youngest Posts (Red River and Lone Star), meetings were held on July 11 and 12, 1945. These meetings featured the novel soldier-for-a-day program described in ARMY ORDNANCE for September-October 1945. The next compound meeting was that of the two oldest Posts in the area—Nebraska and Rocky Mountain (not counting St. Louis, which is the grandfather of them all)—on December 4 and 5, 1945.

On the evening of December 4th, approximately 300 members of the Nebraska Post gathered for their annual meeting to hear Maj. Gen. G. M. Barnes, the honor guest and principal speaker, explain the postwar problems of Ordnance, especially with respect to research and development. In addition, he divulged information on some of the hitherto secret weapons which the Ordnance Department had up its sleeve for the planned invasion of Japan. One of the weapons upon which he expounded was "Little David," the 914-mm. mortar which caused neighbors of the Aberdeen Proving Ground to fear that the earth was quaking when the weapon was proof-fired there about a year ago.

Also present as guest speakers were Col. L. A. Codd, executive secretary of the Army Ordnance Association; Col. C. H. Morgan, chief of the St. Louis Ordnance District; and Col. R. W. Coward, assistant chief of the district. Colonel Codd congratulated the Post on its inspiring meeting and informed the gathering of immediate and future plans of the Association in which the local Posts will, of course, play an important part.

At the speakers' table, in addition to the guests just mentioned, were officers of the Nebraska Post and members of the Post who are well known in the Nebraska Post region for their active support of the Association. The Army Ordnance Gold Emblem was awarded to Karl E. Vogel, president of the Post, for outstanding service to the Association, and another such award was made *in absentia* to "Uncle Charlie" Ammon, Post vice-president, who was prevented from attending the meeting by urgent business elsewhere.

Following the Nebraska Post meeting, Colonel Morgan was "commissioned" an admiral in the Great Navy of the State of Nebraska, thus becoming St. Louis District's second admiral. Colonel Coward, who was similarly commissioned on June 28, 1945, ranks Colonel Morgan in the Nebraska Navy although he is junior to him in the Army. Commission in this navy is granted by the Governor of the state, and an appropriate certificate is issued. Colonel Morgan's initiation consisted of his wearing an admiral's hat and water wings, and placing his right hand in his left-hand trouser pocket while he took the oath of office.

Colonel Morgan says the only advantage of being junior to Colonel Coward is that he can profit by Colonel Coward's mistakes—one of which included the signing of a hotel register as "Admiral Coward." He did just that after a particularly severe initiation. As a result, a local commander and lieutenant commander of the naval district, upon noticing that an admiral was registered at the hotel, lost no time in phoning him and apologizing profusely for not having accorded him the proper reception. Colonel Coward, with his usual aplomb, invited them up to his room and straightened things out by assuring the nonplused commanders, who were puzzled to meet an admiral in an Army officer's uniform, that he was a colonel as well as an admiral.

The Rocky Mountain Post's official program followed the same pattern, with General Barnes' talk followed by a question-and-answer period which proved most interesting and enlightening.

Another meeting of two Posts on two consecutive days is in the making. It is planned to have meetings of the Texas and Lone Star Posts on March 1st and 2nd respectively, and the St. Louis Post has its first 1946 meeting scheduled for March 12th at which Lieut. Gen. Levin H. Campbell, Jr., will be the guest speaker.

NEW IDEAS: Plans and Activities Suggested for Local Posts of A.O.A.

A suggested program of activities and operations of local Posts of the Association has been presented to all Post officials. While Army Ordnance Association Posts are entirely autonomous, there are certain policies relating to their operation with which all should be familiar.

The board of directors of the Association has charted its course and has approved a 10-point program for immediate consideration and a similar program for long-range attainment. These, together with an analysis of the A.O.A. job, were published in the January-February 1946 issue of ARMY ORDNANCE.

Below is an outline of what the Posts can do in furtherance of the A.O.A. program. This is published here as a guide to Post officials in the formulation of future plans and proceedings.

Meetings.—Some Posts hold an annual meeting, others hold meetings more frequently. In view of the great problems facing our national defense, it would seem that at least semiannual meetings are advisable. At these meetings speakers of national or local prominence could be invited to discuss some phase of our general program; resolutions could be adopted placing the Post on record as favoring such objectives. This action could be publicized generally and brought to the attention of opinion-forming individuals and groups within the Post area.

Committees.—Some Posts have found that general interest is sustained among members by committees appointed to study and recommend on particular problems contained in the national program. Reports of such committees can be publicized by the national organization and also brought to the attention of public officials who should be familiar with the views and recommendations of our members.

Educational.—There is an unlimited opportunity for a better understanding of scientific and industrial preparedness in coöperation with the schools and colleges. Through faculty members and R.O.T.C. students we can interest our younger fellow citizens in these problems. To this end, meetings of Posts can frequently be held in conjunction with schools and colleges where faculty members are particularly well equipped to discuss and advise on technical and scientific aspects of Ordnance progress.

Plant Visits.—Some of our Posts find it particularly valuable to schedule once or twice during the year afternoon or daylong visits to governmental establishments—Army, Navy, Air Forces—where research and development work is under way. Proving grounds, laboratories, and commercial plants offer an advantageous method for bringing the members together for social and

professional advancement and for stimulating ordnance interest.

NECROLOGY

Brig. Gen. Charles Elliot Warren, banker, soldier, and Treasurer of the Army Ordnance Association since its foundation nearly 27 years ago, died at his home, Still Pond, Hewlett, L. I., on Christmas Day 1945. He was one of the founding fathers of the Association and had guided its interests with unflagging zeal from the first moment of its organization in 1919 until its last directors' meeting shortly before his death. The Ordnance cause did not have a more zealous, faithful, and talented counselor and friend.

Although he had retired from business ten years ago, General Warren continued his interest in military affairs. From 1910 to 1920 he was president of the Lincoln National Bank, and when that corporation was merged with the Irving Trust Company he became a vice-president and chairman of the advisory board of the Lincoln office of the Irving Trust Company.

He was born in New York, a son of George William and Mary Elizabeth Warren, and after a preparatory education at St. Paul's School, Garden City, N. Y., he became a student at the University of California. In 1882 he entered the banking business.

For his work in the first World War General Warren received the Distinguished Service Medal and from France the Croix de Chevalier de la Legion d'Honneur. He was a member of the staff of Maj. Gen. John F. O'Ryan, commanding the 27th Division in France. He also served on the War Credits Board.

General Warren began his military service in the 7th Regiment and later in the 12th Regiment, New York National Guard. He participated in the Spanish-American War. In World War I he served on the staff of the late Brig. Gen. John T. Thompson, famed small-arms expert. General Warren rendered outstanding service to the Army in this assignment. Subsequently he became a colonel in the 514th Coast Artillery, U. S. Army. He later became a brigadier general in the New York National Guard.

In 1915-1916 General Warren served as president of the New York State Bankers Association. At one time he was president and treasurer of the Erie & Kalamazoo Railroad Company.

He was a member of the Pilgrims, the Mayflower Society, the Society of Colonial Wars, the Colonial Order of the Acorn, the Society of the Cincinnati, the Society of the War of 1812, the Loyal Legion, the Army Ordnance Association, the Veterans of the 7th Regiment, the American Legion, the American Tract Society, the Order of the Runnymede, and the St. Nicholas Society. His clubs included the Metropolitan, the Military and Naval, the Rockaway Hunting, and the Lawrence Beach.

There are many monuments to General Warren's service to the Nation. None of these gave him greater pleasure, we are confident, than the realization of the present financial strength of the Army Ordnance Association. With watchfulness and coöperation he handled the finances of the organization from their beginnings at zero in 1919 to their summit of nearly a million dollars in 1945. In Ordnance and many other achievements in the field of finance and of military affairs, Charles Elliot Warren was the personification of the title "an officer and a gentleman." As such, his memory will long remain great in the annals of Ordnance.

CHARLES ELLIOT WARREN
Soldier, Financier, Patriot

Resolution
in Tribute to the
Late Treasurer, Army Ordnance Association,
Adopted by Executive Committee, A.O.A.

¶ The Executive Committee of the Board of Directors of the Army Ordnance Association, at their meeting in New York City, January 25, 1946, learned with profound sorrow of the death of their fellow member, Brig. Gen. Charles Elliot Warren, and record these expressions of regret on the records of the Association which he served so faithfully from its organization in 1919 until his death, December 25, 1945.

¶ Citizen, soldier, gentleman, financier, humanitarian, and patriot, General Warren exemplified the finest traditions of American leadership throughout his long and useful life. While engaged in his profession as financier for many years, he constantly devoted much of his time and talent to the national defense of the United States. He served with distinction in the National Guard of the State of New York. He contributed to the fine traditions of the state through service in the Veteran Corps Artillery of which he was commandant. He brought to the Ordnance Department, United States Army, an unusual talent when he became a member of its Small Arms Division in World War I, and he gave throughout his lifetime the inspiration of his intense patriotism in every enterprise connected with the national security.

¶ When the Army Ordnance Association was organized in 1919, General Warren became its treasurer. All its finances were under his skillful direction for more than twenty-six years. The strong condition in which the finances of the Association stand at this time are a tribute to his constant care and solicitude throughout all the years of his service to the organization.

¶ The Army Ordnance Association, through its Executive Committee, pays tribute to General Warren in grateful acknowledgment of his outstanding service and directs that these sentiments be spread upon the records of the Association, that they be published in ARMY ORDNANCE, the Association's journal, and that a copy be presented to his family as a mark of our sympathy and sorrow.

Oscar H. Wurster, a charter member of the Army Ordnance Association and a prominent personage in the chemical and oil industries, died at his home in Chicago on January 25, 1946. For many years he had taken an active part in the plans and programs of the Chicago Ordnance District under the direction of the late Edmund A. Russell. He was especially helpful in the peacetime years in assisting with industrial-mobilization plans as perfected by Cols. Walter Soderholm and Reynold F. Mellin.

President of Wurster & Sanger, Inc., chemical engineers, Mr. Wurster was also active in the American Institute of Chemical Engineers of New York. He was born in Ann Arbor, Mich., and was graduated from the University of Michigan, A.B. 1905, M.S. 1906. He developed many processes and equipment used in the oil, soap, and glycerin industries and held a number of patents on processes and equipment used in these industries.

NOTICE has also been received of the deaths of the following members of the Association: V. A. Armstrong, Washington, D. C.; Samuel Benensohn, Chicago, Ill.; S. O. Berggren, Forest Lake, Minn.; Robert Boettger, Yonkers, N. Y.; D. S. Bowers, Tulsa, Okla.; E. E. Boyett, Houston, Tex.; William Cavalier, Piedmont, Calif.; G. H. Cherrington, Pittsburgh, Pa.; L. W. Delesdernier, Danielson, Conn.; B. H. Diblee, San Francisco, Calif.; F. N. Foote, New York, N. Y.; H. J. Frame, Waukesha, Wis.; John Hershey, Troy, Ohio; Louis Kahn, Detroit, Mich.; B. E. Keifer, Cincinnati, Ohio; F. S. McGinnis, San Francisco, Calif.; H. E. Miller, Louisville, Ky.; F. L. Robbins, Woodbury, N. Y.; W. J. Savage, Chicago, Ill.; J. R. Todd, New York, N. Y.; J. H. Vogel, York, Pa.; G. L. Wessinger, Detroit, Mich.; A. F. Young, Portsmouth, Ohio. To their relatives and friends, ARMY ORDNANCE, on behalf of the Association membership, extends condolences.

Biological Warfare

A NEW TYPE OF OFFENSIVE

A type of warfare that might have been employed in World War II—a potential avenue of attack by our enemies—was biological warfare. Intelligence reports revealed that the Japanese Army fostered offensive developments in this field from 1936 until as late as 1945.

During the period between World War I and World War II interest in the possibilities of biological warfare was maintained chiefly by scientists and military men in many countries, but as the interwar period drew to a close, those responsible for the Nation's defense began to give serious consideration to the possible dangers in this field. Brought to the attention of former Secretary of War Stimson in the fall of 1941, Mr. Stimson promptly requested the National Academy of Sciences to appoint a committee to make a complete survey of the current situation and of future possibilities.

This committee—known as the WBC Committee—concluded that biological warfare was feasible and urged that appropriate steps be taken for defense against its use. As a result of this conclusion, Mr. Stimson recommended to the late President Roosevelt that a civilian agency to take full charge of all aspects of biological warfare be established. With the approval of the President, the War Research Service, with George W. Merck as director, was organized in the summer of 1942 and attached to the Federal Security Agency. Extracts of Mr. Merck's report to the Secretary of War follow:

The first major task undertaken was the development of defensive measures against possible biological warfare attack. Measures were taken in coöperation with the Army services to protect the supply of water, food, and milk on the mainland, in Hawaii, the Caribbean area, particularly the Canal Zone, and finally in all overseas theaters.

The major achievement of War Research Service, however, was the organization of a program of research and development to extend the boundaries of knowledge concerning the use of pathogenic agents as a weapon of war and the means of protection against possible enemy use of these agents. All known pathogenic agents were subjected to thorough study and screening by scientists of the highest competence in their respective fields to determine the possibilities of such agents being used by the enemy. Those disease-producing agents which seemed to offer some promise were assigned to various university and private research laboratories for intensive experimentation in terms of their lethal properties, means of production, and methods of protection against their use. As the program progressed, however, it soon became clear that exhaustive investigations of biological warfare agents, their use as weapons, and means of protection against them could not be achieved without larger scale developmental operations.

In November 1942, the War Research Service requested the Chemical Warfare Service of the Army to prepare to assume responsibility for a larger scale research and development program involving the construction and operation of specially designed laboratories and pilot plants. The site chosen for these facilities was at Camp Detrick, Frederick, Md., where construction was begun in April 1943. When these facilities were put into operation, research projects which had been developed under sponsorship of the War Research Service were turned over to the Chemical Warfare Service for further development at Camp Detrick. War Research Service continued to exercise general supervision over the entire field and to sponsor fundamental research studies.

In December 1943, the Office of Strategic Services reported to the Joint Chiefs of Staff that there were some indications that the Germans might be planning to use biological warfare agents. While the evidence that the Germans might use such agents was inconclusive, there was considerable concrete information available from work which had been carried on in the United States, the United Kingdom, and Canada that attack by biological warfare agents was feasible. Accordingly, it was decided in January 1944 to step up all work in this field, particularly in terms of the protection of troops against possible enemy use of these weapons, and to transfer a large part of the responsibility for the biological warfare program to the War Department. The complete transfer was accomplished by direction of the President in June 1944, when the Chemical Warfare Service was made responsible for the program in the War Department with the coöperation of the Office of the Surgeon General on certain important defensive phases. The Navy Department continued to make important contributions to the program and continued to work in close collaboration with the War Department in this field.

Upon assumption by the War Department of full responsibility in this field, the Secretary of War appointed the Director of War Research Service as his special consultant on biological warfare and established the United States Biological Warfare Committee, with Mr. Merck as chairman, to advise him on policy matters and to maintain close liaison with the British and Canadian groups concerned with biological warfare. This committee was composed of representatives of the Chemical Warfare Service; the Office of the Surgeon General, U. S. Army; Bureau of Medicine, U. S. Navy; Bureau of Ordnance, U. S. Navy; Army Service Forces; Army Air Forces; New Developments Division, War Department Special Staff; G-2; and the Office of Strategic Services. A new committee—designated the DEF Committee—was formed by the National Academy of Sciences and the National Research Council to advise the War Department on the scientific aspects of the subject.

IN general terms, some of the more important accomplishments of the program were:

1. Development of methods and facilities for the mass production of microörganisms and their products.
2. Development of methods for the rapid and accurate detection of minute quantities of disease-producing agents.
3. Significant contributions to knowledge of the control of air-borne disease-producing agents.
4. Production and isolation, for the first time, of a crystalline bacterial toxin, which has opened the way for the preparation of a more highly purified immunizing toxoid.
5. Development and production of an effective toxoid in sufficient quantities to protect large-scale operations should this be necessary.
6. Significant contributions to knowledge concerning the development of immunity in human beings and animals against certain infectious diseases.
7. Important advances in the treatment of certain infectious diseases of human beings and animals and in the development of effective protective clothing and equipment.
8. Development of laboratory animal propagation and maintenance facilities to supply the tremendous number of approved strains of experimental animals required for investigations.
9. Applications of special photographic techniques to the study of air-borne microörganisms and the safety of laboratory procedures.
10. Information on the effects of more than 1,000 different chemical agents on living plants.
11. Studies of the production and control of certain diseases of plants.

PROFESSIONAL DIGEST

ORDNANCE TRAINING OVERSEAS

Seventh Army headquarters Ordnance officers have established a highly successful Ordnance technical school at Heidenheim, Germany, to assist veterans in preparing for peacetime jobs. Present enrollment is 255, but it is expected that quotas for each of the units of the Seventh Army will be increased to the point where there will be 700 students taking a 4-week course in any one of 9 specialized subjects.

Planning was started two months before V-E Day for a school for occupation troops to teach the basic elements of shop practice in various trades. As ideas developed it was decided that, by stressing practical instruction as well as theory, the school could serve the twofold purpose of refreshing men in a trade they had previously practiced in civilian life and introducing novices to a possible postwar career.

The J. M. Voith factory at Heidenheim which formerly produced 88-mm. artillery pieces for the *Wehrmacht*, was selected as the site of the school. Ideal facilities existed for practical instruction, but nevertheless a tremendous job of conversion and rebuilding had to be done to meet the exacting standards desired.

During the months of July and August 1945, this work progressed at top speed, with 250 civilians under Ordnance direction laboring long hours to complete the job on time. Floors were torn up and relaid. Walls, partitions, and shop booths were constructed. A complete set of wiring and lighting was installed, along with a new power system, and the grounds of the school were relandscaped. The three main shop buildings and instruction rooms were repainted. The finished product was a technical school that conformed fully with standards of modern educational design.

While this rebuilding job was going forward, additional equipment had to be obtained to supplement existing machinery in the plant. An intensive search was made throughout the American occupational zone for the most modern machine-shop and instructional tools that could be released by the military government.

German ordnance maintenance equipment and factories producing war matériel were fruitful sources. In particular, fine machine tools were found in an underground Messerschmitt factory. Seventh Army collecting points were exhaustively combed for usable matériel.

While the job of converting and securing equipment went forward, the officers of the school staff worked diligently to obtain the best of instructors and student personnel. All Seventh Army units were visited. Interviews were given only to those men whose service records indicated they qualified as instructors. Requisites included both civilian and Army experience in the instructor's specialty as well as a sincere interest in teaching.

On this basis a competent instructional staff was obtained of thirty-five noncommissioned officers, each of whom volunteered for the assignment. This staff will be increased to one hundred as additional classes of instruction are added to the school's program. Student applications were accepted only from enlisted men in Seventh Army units who were literate and evidenced a genuine desire to acquire proficiency in the course selected.

The school area in the factory includes three separate instructional sections. There is a shop for heavy work, 150 by 450 feet, with machine-shop and welding equipment, along with heavy lifting devices for the purpose of carrying vehicles from one area to another. Adjoining the heavy-work room is a second shop, 150 by 400 feet, where the quieter operations are conducted, such as disassembling of carburetors, voltage regulators, generators, and starters, as well as all phases of assembly and disassembly of the Diesel and gas engine and the heavy units. This entire shop is neatly arranged and laid out to facilitate each individual operation.

The third section consists of five separate classrooms and the watchmaking room, with built-in soundproof features whereby the instructor can speak in a normal tone of voice and in turn not be subjected to voice fatigue. In addition to these rooms there is a large auditorium for group lectures and instructional films.

Upon completion of the course students have elected, covering a total of 176 hours of classroom and shop work, they will be granted a certificate of efficiency which will entitle them to high-school and college credits for the course followed. The nine courses offered at present include body and fender work, carburetion, Diesel engine, electric arc welding, general automotive, internal-combustion engine, machine shop, oxyacetylene welding, and watchmaking.

PLASTIC BODY ARMOR

Plastic body armor had been perfected for combat use by Navy and Marine Corps assault troops and fliers by the end of the war.

Laminated glass-cloth combat jackets, which had been given a preliminary test at Okinawa, were ready for the Marines who were poised to storm the shores of Japan. Laminated nylon flak suits had been distributed to Navy and Marine Corps airmen to protect them against heavy antiaircraft fire encountered over the Japanese home islands before the final surrender. Plastic body armor had its origin in the Naval Research Laboratory.

A magazine advertisement in December 1940, which showed Henry Ford hacking with an ax at a plastic automobile fender, helped initiate the Navy laboratory's plastic research program. It caught the eye of Rear Adm. Harold G. Bowen, U.S.N., then director of the Naval Research Laboratory and now chief of the Office of Research and Inventions, who had been following the progress in the development of plastics. He picked up the telephone and called Dr. G. R. Irwin, head of the laboratory's ballistics section, who immediately launched the research work in his section.

Following extensive preliminary work by the laboratory, the Navy Bureau of Aëronautics backed the plastics program with a view to obtaining effective antiflak suits for Navy and Marine Corps airmen. A joint Army-Navy committee was established to evaluate the use of plastic armor by both services.

Although the new Doron armor is lighter, more pliable and more comfortable than steel, it at present has the disadvantage of being bulky. Its use was intended primarily for jackets for ground troops and in Navy life jackets for shipboard personnel.

ED. NOTE.—In an article in the January-February 1946 issue of ARMY ORDNANCE ("Body Armor for Modern Battle," p. 59) Col. René R. Studler tells of the Army's development of protective armor. A combination of aluminum and nylon proved to be the most effective armor, he said.

JAPANESE CYCLOTRONS DESTROYED

A detachment of thirty-two Ordnance men wrote "finis" to the final chapter of Japan's quest for the secret to atomic bomb production on November 24, 1945, when they began cutting up the massive 200-ton atom-smashing machine in the Nishina laboratory of the Institute of Physical and Chemical Research in Tokyo. The complete destruction of Japan's atomic energy research equipment was carried out under orders from the War Department which, on the admission of Mr. Patterson, Secretary of War, were an error. It was a costly mistake.

Meanwhile, atomic research equipment consisting of machines located in the Imperial universities at Osaka and Kyoto was being destroyed simultaneously by Ordnance and Engineer units of the Sixth Army.

At eleven o'clock in the morning, Ordnance men began the

job of dismantling the equipment to bring to an end Japan's search for the atom secret which began in 1935. The job was started just twelve hours after the men had been pulled out of bed to complete final arrangements for the unusual history-making job that lay ahead of them.

After the cooling oil was drained from the coils around the huge electromagnet which had once been an arc generator for Japanese wireless communications to the United States, the Ordnancemen went to work and cut the massive equipment into pieces small enough to transport in trucks to ships waiting to take them out to sea for dumping.

Three Ordnance noncoms comprised the "first team" which began cutting operations on the giant equipment. They were Tech. 3rd Grade Andrew Cavagnaro of Comanche, Calif., Sgt. Robert F. Bailey of Lebanon, Mich., and Sgt. W. H. Gates of Pine Bluff, Ark.

The 32-man team was drawn from the 12th and 172nd Ordnance Battalions of the Yokohama Ordnance Base Depot. It required a 7-truck convoy to transport the men and their equipment from Yokohama to Tokyo.

Lieut. Col. G. C. Tibbitts of Washington, D. C., on temporary duty with the Eighth Army in Yokohama, was in charge of the Ordnance operations in destruction of the equipment at the Nishina laboratory. Colonel Tibbitts was sent to Japan to study Japanese processes in production of ammunition and explosives for comparison with American methods. In Washington he was in the ammunition and explosives section of the Research and Development Service, Office of the Chief of Ordnance.

Maj. Grable Weber of Chicago and Lieut. Kenneth Sims of Three Rivers, Mich., were his assistants in the 4-day job. Major Weber is in the Ordnance maintenance section of the Eighth Army while Lieutenant Sims is in the 3459th Ordnance Medium Automotive Maintenance Company.

A note of irony was injected into the operations by Major Weber's presence. Hanley & Company of Chicago, owned by the major's father and uncle, was the firm which installed the power plant and piping system in the atomic bomb plant at Knoxville, Tenn., in addition to doing some work on the Badger, Ill., Kankakee, Ill., and Sagamon Ordnance Plants. All equipment used in the cutting, removal, and destruction of the equipment was Japanese. Oxygen-carbide torches were used to cut the cyclotron while 5,000 pounds of smokeless powder, originally for use as propelling charges for Japanese guns and for Japanese incendiary charges, were used to demolish the equipment after it had been removed to the outskirts of Kyoto.

The machines involved ranged in size from a small home-made unit once used in a high school and later located in the Osaka Imperial University to the giant 200-ton American-made device at the Nishina laboratory.

Troops accompanied by scientists were moved into the laboratories a few days in advance of the destruction to secure all records, but the Imperial Government and the Japanese scientists did not know that the equipment was to be destroyed until less than two hours before the men arrived with their torches and other equipment.

Scientists moving in with the First Cavalry Division troops to capture the equipment said that the Japanese "had made no important progress along the road to working out the principles involved in the atomic bomb."

CANNED WEAPONS

In the November issue of FIREPOWER an article was published entitled "Can the Army" which described steps being taken currently for the storage and preservation of priceless ordnance equipment in time of peace. The author went out of his way to infer that the idea of canning our large weapons and their component parts is not new but that it originated some twenty-five years ago when a number of recoil mechanisms were canned in oil. When the cans were opened four years ago, the contents were found to be in excellent condition and were promptly supplied to our hard-pressed allies who had little or no artillery left with which to stop the enemy.

There is a twofold moral in the story up to this point. First, we should hold on to our guns and save every one of them for a rainy day. Secondly, develop this canning procedure to the point where the people will provide the necessary money for canning all our equipment which military necessity dictates should be kept for another emergency.

To get back to the origin of the canning idea as applied to major items of ordnance matériel: Small-arms ammunition has been packed in hermetically sealed containers for many years. Complete rounds of mobile artillery ammunition likewise have been packed in a particular type of sealed container.

As far as canning artillery is concerned, the earliest documentary evidence which has come to light is a letter written in May 1926 by the then chief of the Maintenance Division, Field Service, Office of the Chief of Ordnance. The author is Col. Carl A. Waldmann, now commanding officer of Rock Island Arsenal. This letter directed that the arsenal inaugurate a storage test of recoil mechanisms for the 75-mm. gun carriage M1897 which were to be immersed in oil and sealed in airtight containers. Other details were specified.

Colonel Waldmann, who remembers having written the directive, is firm in his recollection that the idea did not originate with him. It is quite possible that it was based on a suggestion made by the then Maj. Levin H. Campbell, Jr., who had just reported for duty in the Ordnance Office after concluding a tour of approximately three years in charge of the Automotive Research Laboratory and Design Section at Rock Island Arsenal. This places the origin of the idea about nineteen years ago and not twenty-five as the author of the FIREPOWER article suggests.

A JAPANESE SEMIAUTOMATIC RIFLE

Almost an exact copy of America's famed Garand rifle was being developed by the Japanese during the closing days of the war, it was revealed when a war matériel recovery team found one hundred models of the Japanese Type 4 gas-operated, semi-automatic rifle in the Washimo Seiki Sawania factory near Anjo in the Nagoya area.

Close examination of the captured weapons revealed that there were three major differences in the two weapons. Compared with the .30-inch bore of the American rifle, the Japanese weapon had a .303 bore which enabled it to use the standard 7.7-mm. Japanese rifle ammunition. A 5-round clip, similar to that used in the Springfield, is used in loading the Japanese rifle. Also, instead of the knob-elevated sight of the M1, the Type 4 weapon uses a leaf-type sight.

The Japanese rifle has an over-all length of 42½ inches and a 23-inch barrel. It is somewhat lighter than the 8.69-pound Garand because of the use of lighter wood in construction of the stock.

Although the designers of the rifle wanted to produce more than the 150 known to have been made, manufacturing facilities just did not exist, and there was a lack of coördination between design and production echelons. The factory was not producing any rifles though it was assembling one hundred rifles for the navy. Work began on the semiautomatic rifles in April 1945, but it was discontinued to make way for all-out production of aircraft engines. During this time only fifty-one rifles had been assembled, and none had been tested. However, special machinery was being shipped into the factory, and it is believed that it was going to be converted to parts production for the new rifle.

SUPERSONICS FOR TESTING POWDER

A process of spraying immense sticks of rocket powder with a solution of aerosol and then testing each grain of powder by underwater vibrations of supersonic frequency is another wartime development that can now be revealed.

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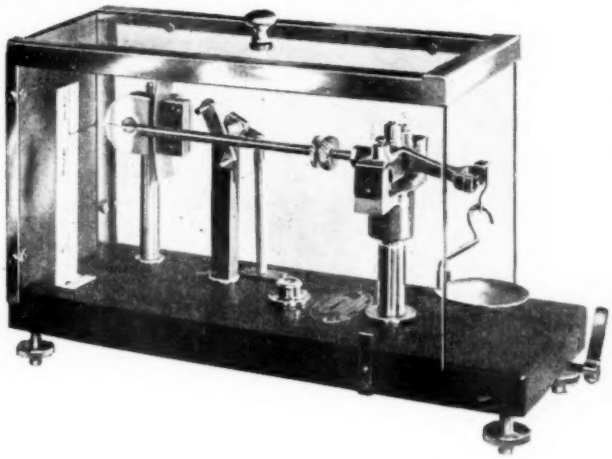

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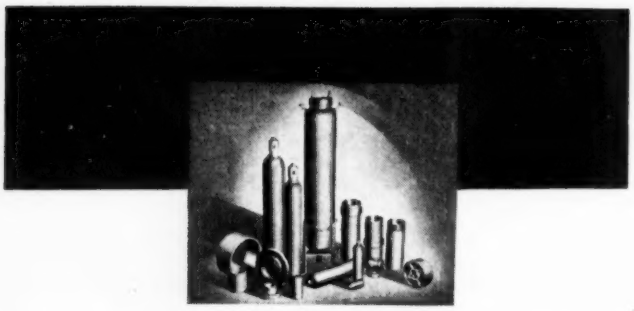

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Professional Digest

Technical experts at America's largest rocket-powder plant, the Sunflower Ordnance Works, located near Lawrence, Kans., developed the use of X-ray to detect internal flaws in rocket powder. Close internal inspection of every grain of the powder is necessary to guarantee "straight shooting," because an imperfect stick of powder might cause the rocket to fall short of its mark.

X-ray inspection of powder was thought to be very successful —until it was noted that this one rocket-powder plant in Kansas was using up more than forty per cent of all the X-ray film available in this country! The Hercules Powder Company of Wilmington, Del., operator of the Sunflower Ordnance Works, set out immediately to develop a more practical method of inspecting rocket powder.

Research work was begun at the development department of the Radford Ordnance Works, a Government-owned Hercules-operated plant at Radford, Va. Some of the most outstanding chemists and physicists of the Nation were called upon to help develop this supersonic inspection of rocket-powder grains. They did not see why supersonic waves couldn't be used to detect fissures in powder, much the same as supersonic waves are used to detect flaws in rubber tires.

Original supersonic investigation of rocket-powder grains was carried out using a single set of transducers built by the Brush Development Company of Cleveland, Ohio. In studying grains previously examined by X-ray, the presence of flaws was confirmed in all grains which had failed X-ray.

But there were many problems to be met in applying supersonics to rocket powder. First of all, the powder contains over forty per cent nitroglycerin. How could the machinery be made safe to carry this high explosive? If sticks of this powder were dipped into water, would this affect the explosive property of the powder? How could the size of the flaw be shown in relation to the span of the sound wave?

Machines were built of brass and bronze, nonsparking metals, and by means of test after test it was adequately demonstrated that the stability of the powder was not affected by wetting.

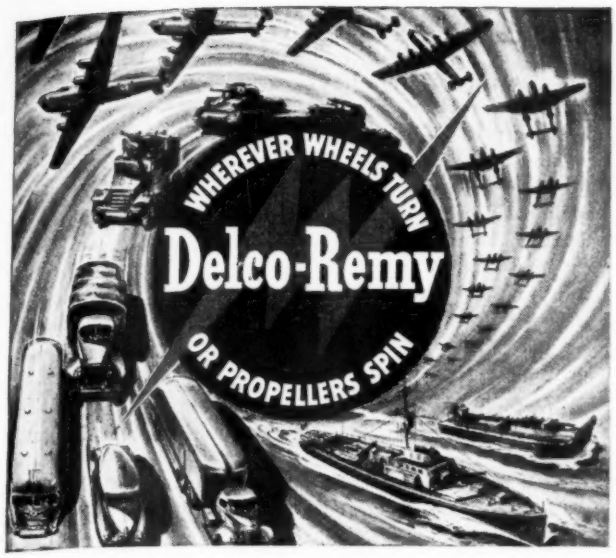
It was determined that the frequency of the supersonic wave used was most critical. The frequency audibility of the human ear ranges from approximately 20 cycles to 10,000 cycles a second. In comparison, a frequency of 440,000 cycles a second was established as the base standard for supersonic examination of rocket grains.

The War Department gave the "go signal" late in the winter of 1944 for construction of a supersonic house on a rocket-powder line at Sunflower. Supersonic operations began on a "'round-the-clock" basis on May 2, 1945. Shortly thereafter a minimum average of 2,500 sticks of rocket powder were being inspected by the supersonic process each day. The cost of X-ray film to inspect rocket powder for one week would practically pay for the entire supersonic unit.

The Sunflower supersonics house contains a concrete tank eight feet wide and approximately twenty-two feet long. The tank itself is divided into two sections: a small 6-foot section at the head end is for the wetting agent; the remainder of the tank is filled with water maintained at an operating temperature of eighty degrees Fahrenheit by means of a steam injector.

The head end of the tank is fitted with two feed mechanisms and two brass feed tracks inclined at fifteen degrees which extend almost to the end of the tank. A ring jet of copper tubing surrounds each track at the head end and is used as a spray for the aerosol solution. Felt pads mounted on springs wipe the excess aerosol from the powder grain before it enters the clear-water section of the tank.

Six sets of sending and receiving transducers are rigidly mounted in a bronze cage. They are arranged in such a manner that each section of a stick of powder is scanned. Six sending crystals have a common power supply while the recording



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crystals have individual amplification control. The power supply, sound generator, amplifiers, and transmitter are mounted in a cabinet located for safety purposes in a small concrete instrument house at the side of the main building.

From the instrument panel a shielded cable connects the receiving transducers with the recorder which is located in the tank room at the discharge end of the scanning tank. Each receiving transducer actuates a pen mechanism in the recorder that draws a line on graph paper moving at the speed of $^3/_{32}$-inch a second. Since the grains move at one inch per second and the paper moves at $^3/_{32}$-inch per second, a 40-inch grain is represented on the record by a line about 3¾ inches long.

After passing through the transducer cage, the grain of powder is pushed onto a counterweighted trip pan from which it is dropped onto a brass receiving tray and lifted from the tank by means of flat brass hooks fitted onto a sprocket chain. The scanned grain discharges onto a rubber-covered table directly beneath the recording device.

The person at the recorder, called a "scanner," marks each grain as follows:

"OK Supersonics"—for good grains, or "X-ray"—for grains showing small defects as determined by small peaks on the recording or by deflections due to metallic material. X-ray of these slightly defective grains is necessary because metal material in a grain of powder and air fissures are recorded as alike in supersonics. X-ray shows a metal particle as white and a fissure as black. In order to pass Government specifications, a grain of rocket powder cannot have a single air fissure.—L. R. FISHER.

WHERE RADAR FREQUENCIES COME FROM

The heart of a radar set is the device for generating superhigh frequencies—from a few hundred million to a few thousand million cycles a second, and two new names of generators of megacycle power have joined the technical man's language—the resonant magnetron and the klystron. The basic concept of the magnetron was born in England, while the klystron notion was conceived by two men working at Stanford University.

The magnetron is the megacycle power generator, and hence is the tube commonly used in radar transmitting sets where large power outputs are desired. The magnetron, at the war's beginning, had the relatively weak peak output of a few kilowatts. The new magnetrons can deliver up to a thousand kilowatts during the millionth-of-a-second pulses.

In the magnetron's operation electrons are emitted from a cathode in the center of an evacuated chamber placed in the field of a strong magnet. The electrons are forced into spiral paths toward smaller, narrow-neck resonant cavities around the central chamber. When the electrons move through the electric field extending into the central chamber from the resonant cavities in the direction such that their velocity is reduced by the electric field, high-frequency power is generated in the cavities which can be delivered to a transmission line.

Although the magnetron is a high-peak power device its frequency cannot be readily varied over a broad band once it has been assembled. A high-frequency tube more easily tunable over a broad band is the klystron, although less peak power can be obtained from it. Electrons from a cathode are hurled through a cavity toward a reflector. A high-frequency oscillation has been established across the cavity. Hence at one instant the electrons are hastened in their flight by the electric field. The electrons arriving in the cavity an instant later find themselves in an electric field of reversed polarity and hence are retarded. After the electrons leave the cavity they move toward the reflector, which has a negative voltage. Before they reach the reflector they are turned back to the cavity by the reflector. In traveling toward the reflector and back to the cavity, the variation in velocity produced in the cavity results in a high-frequency electronic current, which delivers ultrahigh frequency power to the cavity.

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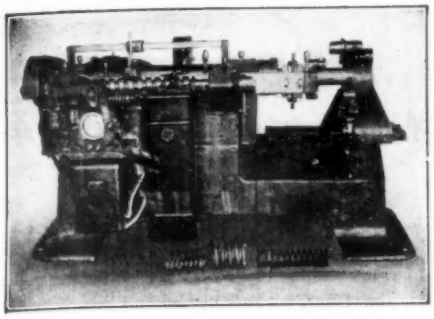

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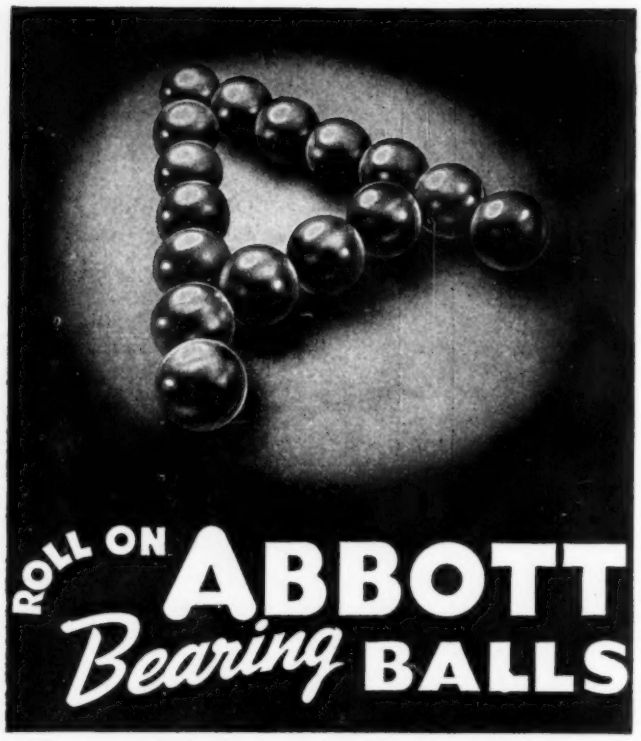

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Tank versus Tank

Were German Armored Vehicles Better Than Ours?

LIEUT. COL. ALBIN F. IRZYK

"THE American tank is not nearly as good as the German tank." "Next to the German and Russian tanks, the American tanks are the best in the world."

Quotations, opinions, and comments similar to the two above which have been widely publicized and which have caused widespread discussion have been made by various individuals. Because they have, to a certain degree, jumped to hasty conclusions, and because they have helped fashion many erroneous conceptions, I shall attempt in this article to present considerations which they have apparently overlooked and which may change the outlook of many on American tanks.

In making those statements, what standards did the persons involved use? What were the items and factors that they utilized in making their comparisons?

If they used simply the gun, the weight of the tank, the width of the track and thereby the flotation of the tank as a criterion, as I am sure they did, then I heartily concur with them that the German Tiger tank is unquestionably superior to the American Sherman tank.

The German 88 *is* more powerful than any American tank gun used during the course of most of the war. The German tank *is* much heavier and therefore its armor is much thicker than that of any American tank. The tracks of the former *are* much wider, with perhaps a less vulnerable suspension system than that of the latter.

If I stop here, as I am convinced so many have, there is no question but that the German tank is a much better one than our own. In this paragraph there is material, indeed, for sensational headlines in newspapers.

Today, however, let us not stop here. Let us go on! What is the fuel capacity of the German Tiger tank? How long and how far is it able to run on a tankful of gasoline? Does it burn much oil? What is the composition and life of its tracks? How many rounds of ammunition is it able to stow? What is the life (discounting its being hit in action) of a Tiger tank? Is its engine comparatively free of maintenance problems? If maintenance problems occur, are they easy to remedy? How long and how much skill is required to change an engine?

Is the German tank able to move for long distances and continuous periods at a steady rate of speed? How is its endurance? Could 53 Tiger tanks, for instance, move from the vicinity of Fenetrange, France, in the Saar, to an area near Bastogne, Belgium, a distance of 151 miles, in less than 24 hours to answer a fire call as did tanks of the Fourth Armored Division?

Did it occur to the critics of the American tank that perhaps questions like those listed above, the answers to which will all heavily favor the American tank, and many others like them, should be considered before a decision is reached? Obviously not. I say most emphatically that such factors *must* be included before a thorough, honest, and fair comparison can be made and a sound and intelligent conclusion reached.

On June 6, 1944, and for many days afterward, while the Ger-

Colonel Irzyk was attached to headquarters of the 8th Tank Battalion. This is a digest of his article published in the January 1946 issue of the *Military Review*.

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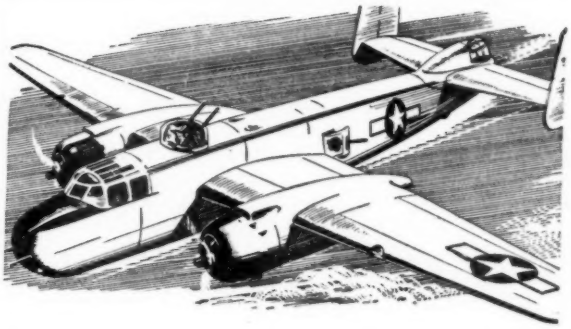

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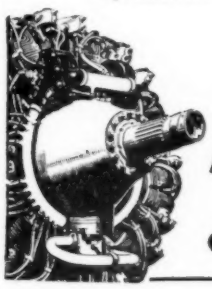

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Tank versus Tank

mans had the Mark V Panther with a 75-mm. gun and a Mark VI Tiger with an 88-mm. gun, the American Army was equipped with the M4A1 Sherman tank. It weighed approximately thirty tons and had a 75-mm. gun. Its tracks were narrow and consisted of three different types: steel, flat rubber, and rubber chevron.

In order to keep rolling over hot roads for long, dusty miles for days on end, a light, mobile tank was needed which the terribly extended supply line could adequately furnish with precious gasoline. To withstand the terrific beating the tank was taking hour after hour, it was necessary for it to have a simple yet tough and efficient engine and mechanical system.

The fact that the American tanks rolled with but few maintenance problems, and those rapidly attended to by the tank crew alone or by company, battalion, or division maintenance, all of which were close enough behind to repair the vehicle rapidly and send it immediately back into action, testifies to the excellence of the tank.

Thus, tank units were still at full strength and functioning efficiently when they reached as far east as the Meuse River early in September after moving and fighting consistently day after day from the Normandy Peninsula. During that phase of operations a group of tanks had made a forced march of 258 miles in 38 hours and arrived in good enough shape to have continued on had the situation warranted it.

IN discussing tanks, many forget that the tank is *not* a vehicle built primarily to fight other tanks. Rather, its mission above all others is to get into the enemy's rear areas, to disorganize him, to destroy supply and communications, and generally to wreak havoc there. This is done mainly with its caliber .30 machine guns, especially the one mounted coaxially, and with high-explosive fire from the tank cannon. The tank cannon's chief function, however, is to protect the tank while it is disrupting, exploiting, and destroying the enemy. Of course, very often a few well-placed shots from the tank cannon will be much more effective than the caliber .30 machine guns, and therefore the cannon is used very frequently in offensive action.

The tank served its primary mission gloriously in that dash through France. Its opponent was dazed, disorganized, and on the run. Most of his equipment was "thin-skinned," and was "duck soup" for our tanks. The caliber .30 fire, and 75-mm. high-explosive fire for good measure, was plenty good enough to leave much of the German Army equipment strewn by the wayside.

A factor rarely considered, yet on occasion vitally important, is the type of bridge that a Sherman can use to cross a stream or river. Many bridges that are adequate for the American tank would pose a knotty problem for the German tank. The bridge would have to be much wider and much stronger, and would require a great deal of time and more facilities to construct.

It was late in 1944 that the American tank became the target for taunts and criticism. Forgotten quickly were the results it had gained just a month or two before. In October, November, and December the ground became a sticky morass; the war was stabilized, and no great advances were being made. Fighting was bloody and difficult, slow and discouraging. For every yard wrested from the enemy, tremendous effort had to be exerted.

During this stage of the war, the tanks could not perform as they had earlier. Rather, they were forced to fight tank versus tank. Here the German had a tremendous advantage. He was fighting a defensive warfare, and the terrain was admirably suited for him. Without a doubt the tank of the Germans was ideally suited for such a fortunate turn in the war. The tank could pick dominating ground and, with its huge gun and thick armor, proved to be a roving pillbox par excellence.

The Sherman's 75-mm. gun proved to be comparatively ineffective during this chapter of the war. At 1,000 to 1,500 yards

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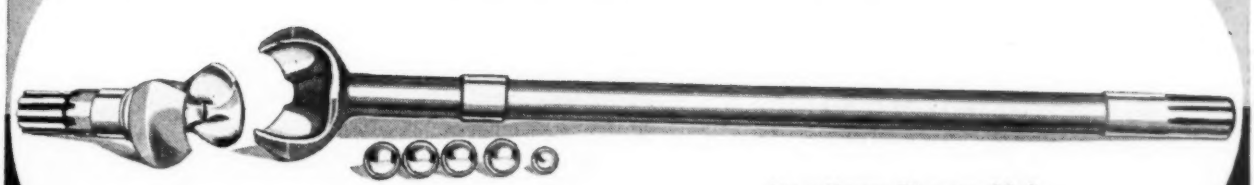

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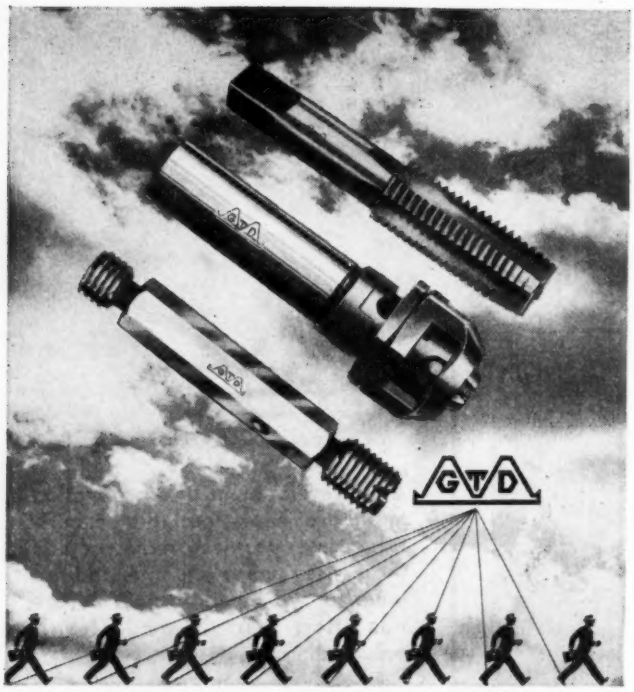

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it could be effective, and a single tank has knocked out 5 Panther tanks with 6 shots. Yet to get that close to a German tank made the Sherman vulnerable indeed. Many tanks were lost in endeavoring to get in close, which was necessary in order for them to strike a telling blow. The absence of an effective armor-piercing shell proved to be a terrific handicap as well. Thus, during that siege, the American tank was impotent when running into the German tank head-on.

Still, it must not be forgotten that though the cards were stacked against the American tank it defeated the enemy and gained the desired ground. Though the Shermans were easily bested tank for tank, they could always bank on a numerical superiority, which fact was considered in our tactics and strategy.

THE closing days of 1944 and the early part of 1945 found a new type Sherman joining the ranks of American tanks and replacing its tired brothers. Although it has no additional armor and weighs but a ton or two more, it arrived on the scene with a potent, long-tubed 76-mm. gun with muzzle brake and high muzzle velocity that makes it effective at much longer ranges than the 75-mm. As a result it is not necessary for the new tank to get as close in as the old tank before becoming effective. A new type, high-velocity, armor-piercing shell was added for the gun and gives it far greater penetrating qualities.

The new tank has an engine with a higher horsepower which makes it capable of higher speeds. Its track is much wider, and it has a new type track-suspension system which gives it more stability and cross-country mobility with which to combat adverse ground conditions. The tank has the traditional endurance of American tanks and rolls consistently for endless miles. It goes ninety miles and often more on a tankful of gasoline.

Even though the German tanks were much heavier and thicker than ours, their armor was centralized. Most of it was on the front slope plate and turret. Sides and rear were often vulnerable, and how we capitalized on that! The armor on German tanks was generally poor. It often cracked on impact, leaving ragged, gaping holes, whereas the holes in our tanks were clean, circular, and easily repairable.

The Germans developed a gun with a high muzzle velocity and an effective armor-piercing projectile. To do this they sacrificed space in the tank, for they had to increase the size of the shell and thus could not stow many rounds.

It must be mentioned that once again the Germans lost sight of the purpose and function of a tank and thought primarily of destroying other tanks. Still, though our muzzle velocity was less than theirs, our high-explosive fire was just as effective. Of the two, the high-explosive fire was for us the more important consideration.

Still another item often overlooked is that it was necessary for us to carry an adequate basic load of ammunition and gasoline in our tanks, for to replace what we used we had to call upon trucks that had to travel over a long, dangerous supply route. The Germans, on the other hand, sat close to their ammunition and other supply. It might astonish some to know that prisoners of war claimed that some of their large tanks had a running time of a mere 2½ hours on a full vehicular load of gasoline. Thus the tanks did not have the endurance nor the cruising ranges of our tanks. Therefore in many instances they had to be transported by rail virtually to the front lines, unloaded, and put into the battle. How far could we have gone with our tanks if we had had to follow a procedure like that?

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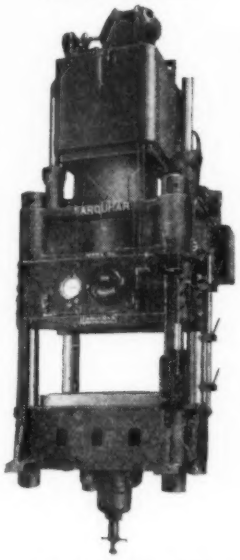

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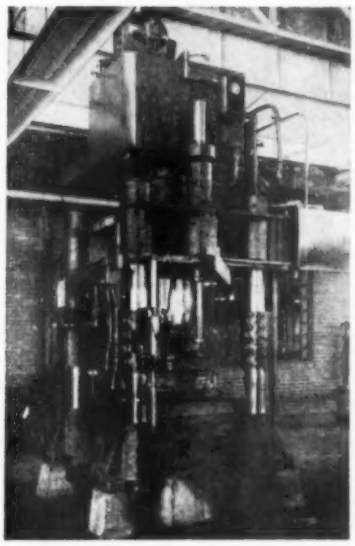

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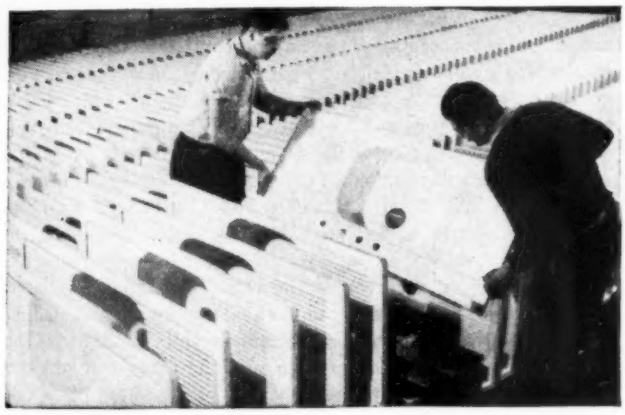

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Machine Guns

U. S. Machine Guns, 1895–1944, Part V

Maj. B. R. Lewis

THIS is the final installment of a series of articles on the machine guns of the United States which was written exclusively for ARMY ORDNANCE. This concluding installment discusses further caliber .50 types and presents a general summary of light machine gun development.—EDITOR.

In 1936 the Spanish Civil War provided a proving ground for a number of new weapons and tactical concepts of their use. Several types of 20-mm. automatic guns were tried as aircraft, antiaircraft, and antitank weapons. At this time, an honest doubt arose in the United States as to whether the caliber .50 machine gun was about to become obsolete. Many thought that an explosive projectile with a supersensitive fuze was needed for aircraft or antiaircraft use and that something heavier than the caliber .50 was necessary for antimechanized defense. Experience with Russian matériel in Spain seemed to indicate that the greater volume of fire and flat trajectory obtained with multiple caliber 7.62-mm. guns was more effective than the explosive projectile and low velocity of the 20-mm. gun.

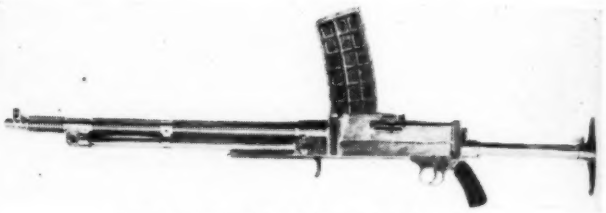

Fig. 22. Berthier Light Machine Gun

In 1937, steps were taken to reëvaluate the caliber .50 machine gun, and the Air Corps, Cavalry, and Coast Artillery Corps began extensive tests. Oerlikon, Hispano-Suiza, Solothurn, and Madsen light automatic cannon were tested in comparison. The issue was decided in favor of the caliber .50 gun. The larger weapons were limited as to ammunition supply which could not be increased materially within space and weight limitations. This was a decisive factor, considering our long-range-of-flight conception of aircraft employment.

The caliber .50 gun was improved by increasing the rate of fire and by reducing the time of flight of the projectile. The Air Corps and Coast Artillery were satisfied with the M2 aircraft and water-cooled guns respectively, and the Cavalry retained the heavy-barrel gun for defense in forward areas, though they expressed a desire for something larger as the principal antimechanized weapon. The Infantry decided to employ the heavy-barrel gun in a similar manner in front-line units. Four of them were added to each battalion heavy-weapons company, in addition to their caliber .30 machine guns and 81-mm. mortars.

All the current models of Browning caliber .50 machine guns can be fed from either side by repositioning the parts in the belt-feed group, the bolt, and the feedway. Similarly, operating or retracting slides can be changed from one side to the other. The basic aircraft gun has a 36-inch barrel. The water-cooled gun has a 45-inch barrel, though a few older ones of thirty-six inches

Major Lewis is assigned to the historical section, Office of the Chief of Ordnance.

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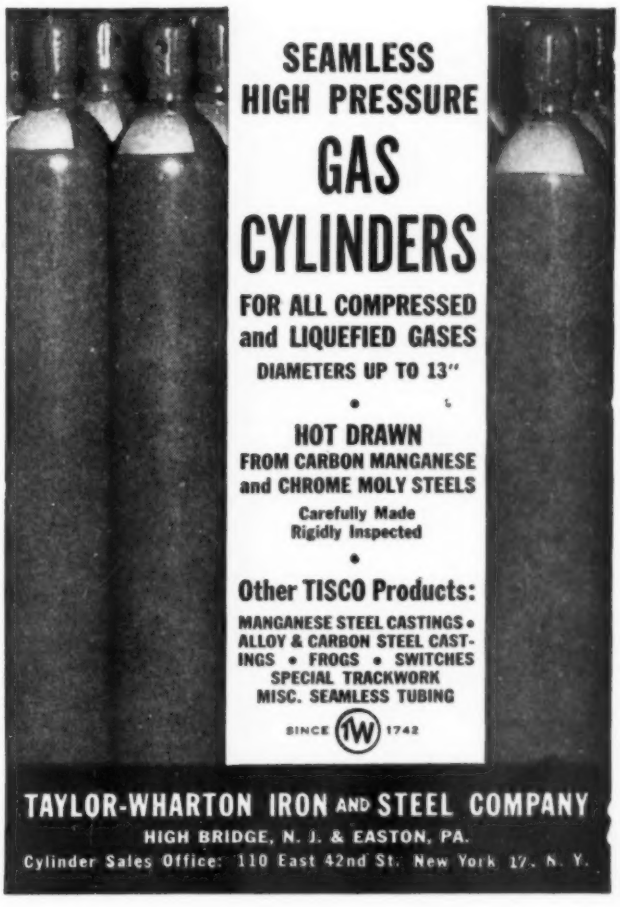

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are still in service. The heavy-barrel gun is also equipped with the 45-inch barrel. Any type of caliber .50 barrel, light or heavy, air- or water-cooled, may be attached to any caliber .50 receiver. By changing the back-plate assembly, any air-cooled gun may be adapted for either fixed or flexible use.

This feature of interchangeability among types of guns has proved of tremendous value during the war. Production has been flexible, and guns have been available in emergencies for simple

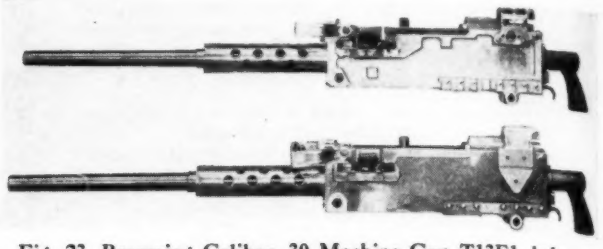

Fig. 23. Browning Caliber .30 Machine Gun T13E1, below; Caliber .30 T13E2, above

conversion. The rates of fire are: for the aircraft basic gun, 550 to 850 rounds a minute; for the water-cooled type, 500 to 650; and for the heavy-barrel type, 400 to 500 rounds a minute.

FOR many years the Ordnance Department has encouraged the development of a lightweight, air-cooled machine gun with a low cyclic rate. Many models submitted by inventors have been thoroughly tested, and samples of new guns in use in foreign countries have been obtained and tried out.

Berthier Light Machine Gun.—Toward the end of World War I, the Berthier light machine gun (Fig. 22) appeared to have desirable characteristics, and The Adjutant General approved the purchase of 5,000 for extended service test. These guns were to be made by the United States Machine Gun Company, Boston, Mass. An order was placed, but the sponsors of the Berthier were unable to locate a factory for its production before the end of the war, when the contract was canceled.

The Berthier gun was never manufactured in the United States on a production basis. There were various test models varying in weight from fifteen to twenty pounds. It was a gas-operated, air-cooled gun, using a 25-round magazine. It could be fired single shot or full automatic, at a rate considered satisfactory.

The project for development of a light machine gun for cavalry and infantry has been active almost continuously since the end of World War I. It is far from a simple undertaking to combine all desirable characteristics of a single weapon suited to both arms, and within the infantry weight limitations. Various modifications of the Browning guns were tried, and many foreign

Fig. 24. Colt Light Machine Gun

guns were purchased and tested. The Browning automatic rifle was improved for use as a substitute standard light machine gun. Springfield Armory conducted an active study of practically every known type of mechanism, including an examination of United States and foreign patents.

Availability of the BAR, together with the need for concentrating effort on completion of the U. S. rifle, caliber .30 M1, led to the postponement of active work on the machine-gun pro-

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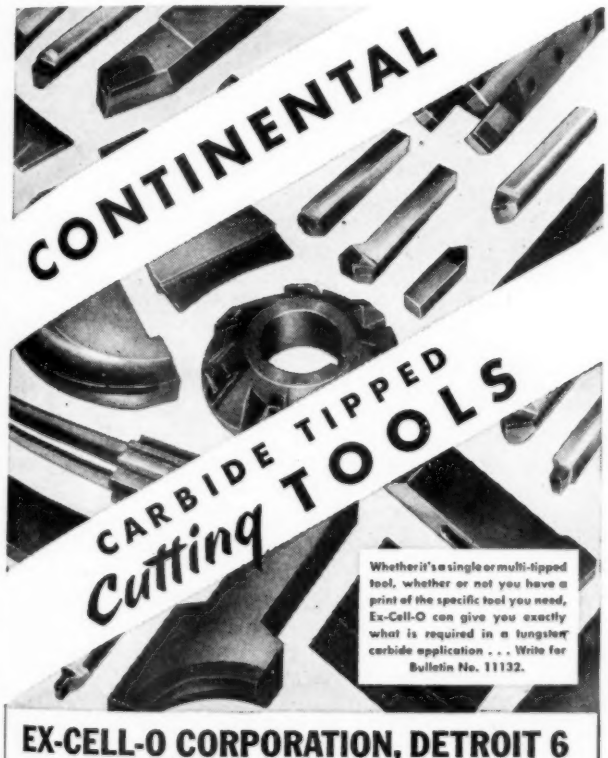
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ject. The information gathered had been negative in that no gun had been found which combined all the needs of the service in a single weapon or which was superior to those which were already available.

In 1939, a new start was made when, on November 24th, the Ordnance Department recommended military characteristics for a new light machine gun to The Adjutant General. This was to be an air-cooled, automatic or semiautomatic (selective) weapon, weighing not over twenty-two pounds and not over thirty-eight inches in length. Stability and accuracy with 5-round bursts were to be at least seventy-five per cent as good as those of the 1917 gun. The piece was to be capable of firing five 100-pound bursts in five minutes. On April 1, 1940, inventors and arms manufacturers of the United States were given the characteristics of the gun desired and invited to submit models for competitive trial.

A SUBCOMMITTEE of the Ordnance Committee was appointed to conduct the light machine gun investigation. This group consisted of representatives of Ordnance and the using arms. The first meeting was held on September 25, 1941. Some sixty persons had shown interest in the matter, and the following had indicated that they would submit samples: Springfield

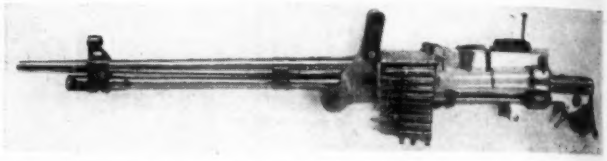

Fig. 25. Sedgley Light Machine Gun

Armory; Rock Island Arsenal; Colt's Patent Fire Arms Manufacturing Company, Hartford, Conn.; R. F. Sedgley, Inc., Philadelphia, Pa.; Auto-Ordnance Corporation, Bridgeport, Conn.; and Schirgun Corporation, Brooklyn, N. Y.

At the next meeting, on October 10, 1941, the competing guns were presented for visual examination. Tests were commenced at Aberdeen Proving Ground on October 13th, and completed on November 10th. These included cold-chamber and photographic stability trials not originally planned.

Springfield Light Machine Gun.—The light machine gun submitted by Springfield Armory was a modification of the caliber .30 Browning M2. The rate of fire could be controlled by a speed regulator at any rate up to a maximum of 800 a minute. This gun was considerably lighter than others of its type, weighing just over twenty pounds. Its over-all length was thirty-seven inches.

Rock Island Light Machine Gun, T13E1.—The Model T13E1 light machine gun (Fig. 23) submitted by Rock Island Arsenal was a modification of the caliber .30 Browning, Model 1919A4. The original objective of the T13 series was to permit head space adjustment from the front. Improvements included a reduced rate of fire, better feed with increased cartridge lift, and some reduction in weight, with a minimum of modifications. This gun was fabricated after a few weeks' study and, though a bit overweight, passed the prescribed tests as it was superior to the other guns submitted.

A second gun, the T13E2 (Fig. 23), was submitted to show the possibilities for further weight saving, with additional modifications. The T14 model also was developed at Rock Island Arsenal but was not submitted for test.

Colt Light Machine Gun.—The light machine gun submitted by Colt (Fig. 24) was basically the caliber .30 M2 aircraft type, modified to meet the specifications for a light tripod gun for infantry and cavalry use. A heavy, 12.4-pound barrel was used. The design incorporated a retarding mechanism of the clock-escapement type to provide a rate of fire between 300 and 350

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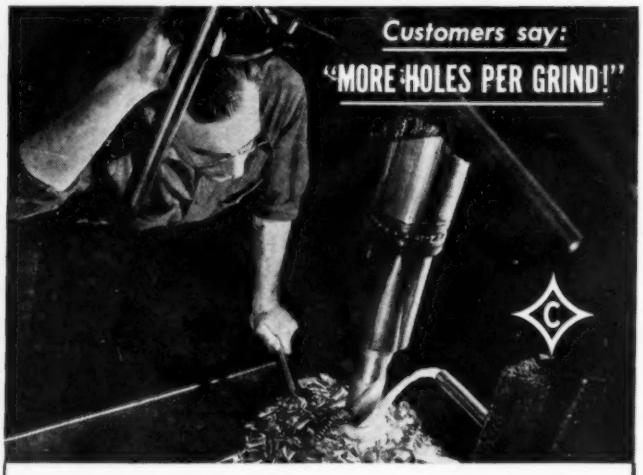

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rounds a minute. The over-all length was 38 inches, and weight with carrying handle was 21.75 pounds.

Sedgley Light Machine Gun.—The Sedgley light machine gun (Fig. 25) was gas-operated. It used a special belt link, in which the fired case was replaced on extraction. Semiautomatic or full-automatic fire was optional. The gun weighed 23.5 pounds, and its over-all length was 38 inches. This gun did not perform satisfactorily and did not complete the test.

Auto-Ordnance Light Machine Gun.—The Auto-Ordnance light machine gun (Fig. 26) of the Ruger design, was also gas-operated. With a cartridge as the only tool it could be disassembled and the barrel changed quickly. The rate of fire was 600 rounds a minute. Either semiautomatic or full-automatic

Fig. 26. Auto-Ordnance Light Machine Gun

operation was available. The gun weighed twenty pounds and its over-all length was thirty inches.

Schirgun Light Machine Gun.—The Schirgun light machine gun was designed by Henry B. Schirokauer, a German citizen. It was gas-operated and had a cyclic rate of 200 to 600 rounds a minute controlled by variation in trigger pressure. The gun weighed twenty pounds and was thirty inches long. It was not fired in the tests. Its development had not been completed, and as submitted it appeared weak. It was resubmitted in February 1942, when it failed to fire satisfactorily.

The committee reported at its third meeting on November 27, 1941, that none of the entries showed sufficient promise to warrant service tests. It was thought that the Auto-Ordnance entry merited further development. The opinion was expressed that light machine gun specifications should be revised and brought up to date.

T10E1 Light Machine Gun.—On January 8, 1942, one light machine gun, caliber .30 T10E1, was shipped to Aberdeen Proving Ground for test. The original T10 had been tested in 1935 as a tripod gun. The E1 had a shoulder stock added, a light barrel more easily detached, and other minor changes. It resembled the BAR in functioning. On test, it lacked reserve power necessary to feed and fire on the closing stroke of the bolt. It offered promise, but redesign was required.

T10E2 Light Machine Gun.—In March 1942, the T10E2 light machine gun (Fig. 27) was fired at Aberdeen. It incorporated most of the improvements suggested for the previous model, the T10E1, and was the best gun tested up to that time. With bipod, the gun weighed 22.5 pounds. Changes in the firing pin and gas

Fig. 27. Light Machine Gun T10E2

cylinder, together with several other less important modifications, were recommended.

MG34 German Light Machine Gun.—In the spring of 1942, a German MG34 gun was received for test. This gun had been reported as very efficient and easily manufactured. The weight with bipod was 26.75 pounds. It was quite simple and easy to disassemble in the field. It would not, however, have been easy to make on a production basis. Its general functioning was ex-

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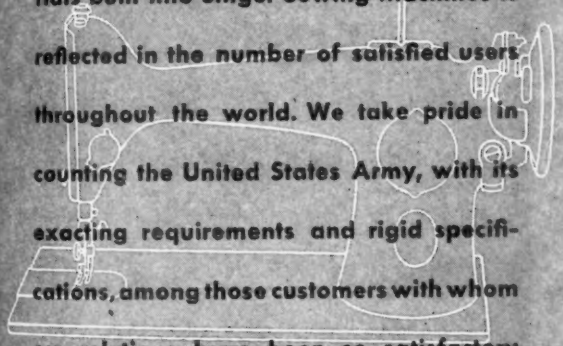

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cellent, but it was found extremely critical as to adjustment, lubrication, and foreign matter. Full-automatic accuracy was poor due to recoil and shock to the gunner's shoulder. Rate of fire was about 600 a minute, stability was good, and ease of changing a hot barrel was excellent.

Aberdeen Proving Ground's Report No. 203 on program No. 5082, dated May 1942, stated that in general this gun was not considered adaptable to American manufacturing methods and was unsuited to the American soldier because of its inaccuracy. As most of the machined parts of the gun appeared to have been lathe-turned, it seemed at first glance easy to make. However, many intricate milling and cam cuts were required on the bolt alone, and estimated production costs were high.

On April 21, 1942, the subcommittee on light machine guns recommended new specifications among which were: increase of length to forty-seven inches; bipod type with shoulder stock, capable of tripod mounting; and selective automatic and slow-automatic fire.

Johnson Light Machine Gun, Model 1941.—In the summer of 1942, a light machine gun, Model 1941, was submitted by Johnson Automatics, Inc., of Boston, Mass. Following minor modifications and preliminary test firing at Aberdeen Proving Ground, five of these guns were sent to Fort Benning, Ga., for further test by the Infantry Board. When fired semiautomatically, the bolt was closed and locked prior to discharge, but in full-automatic operation this was an open-bolt gun. It weighed 15.88 pounds with bipod and loaded magazine. Rate of fire was 600 rounds a minute.

Fig. 28. Light Machine Gun T23E2

This gun was issued to a battalion of United States Marines in the South Pacific, and 125 more went to the First Special Service Force—mountain troops organized somewhat on the order of Ranger units—in Italy. Nearly all reports received from the field on these weapons were favorable, though their use was limited.

Turner Light Machine Gun.—On September 14, 1942, Russell J. Turner, Butler, Pa., submitted a light machine gun for test. With bipod and empty magazine it weighed 18.83 pounds. The over-all length was 41.375 inches. This weapon was withdrawn by the inventor before completion of the tests.

T23 Light Machine Gun.—In the spring of 1943, the light machine gun T23 (Fig. 28) was turned over to Aberdeen Proving Ground for test. It was a modification of T10E3, in which all possible machine cuts had been altered to straight or broaching cuts. Several other improvements had been made. The gun weighed 22.5 pounds and was 46.75 inches long. Malfunctions occurred after firing about 400 rounds at the fast rate, and need for further improvement was indicated. A light machine gun was still an urgent requirement.

Johnson Light Machine Gun, Model 1944.—The Model 1944 Johnson light machine gun (Fig. 29) was a modification of the 1941. It was tested at Aberdeen Proving Ground between January 13 and 20, 1944. It weighed 14.81 pounds equipped with a monopod barrel support. The mechanism was simple and easy to disassemble. In the tests, semiautomatic accuracy was good. The gun did not tend to climb unduly during full-automatic fire, but accuracy was unsatisfactory. The general functioning was good.

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but the piece had a high cyclic rate, and performance under adverse conditions—dust, mud, cold, and rain—was not acceptable. The report on the test stated that the weapon had many good points but recommended improvements to provide a longer operating handle, a lower rate of fire, and better operation under adverse conditions. Late in 1944, based on further Aberdeen tests and recommendations of the Marine Corps Equipment Board, ten of these guns were ordered for service tests. Delivery was expected about March 1945.

T24 Light Machine Gun.—In 1943 specimens of the German MG42 light machine gun were obtained by the Ordnance Department. Though operating at a high cyclic rate—1,050 rounds a minute—it had several desirable features. To study the possibilities of this design, a contract was given to the Saginaw Steering Gear Division of General Motors, at Saginaw, Mich., for conversion of two of the MG42 guns to use the United States caliber .30 cartridge. To expedite completion of the guns, the

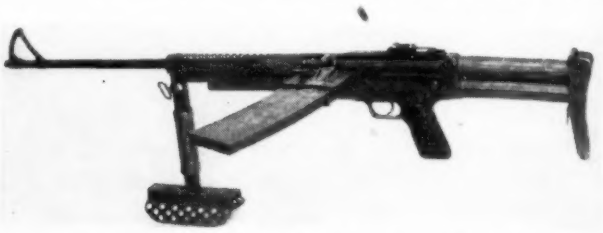

Fig. 29. Johnson Light Machine Gun, Model 1944

Saginaw contract was terminated in December 1943, parts and materials involved being shipped to Springfield Armory. The guns, designated type T24, were assembled and shipped to Aberdeen Proving Ground, where they were tested during the period January 24 to February 12, 1944.

A number of defects were at once apparent due to use of dimensions applying to the German 7.9-mm. cartridge. Necessary changes were made, and the firing characteristics of the gun were determined. The T24 weighed 27 pounds and had an overall length of 46.875 inches. The rate of fire was variable—500 to 600, or 250 to 300 rounds a minute. The stock was found uncomfortable, and the action was susceptible to dirt.

The trigger and feed mechanisms were very good, and the quick-change barrel feature proved desirable. But since development of other types had made satisfactory progress, it was decided that further work on this gun was not warranted. Tests showed that this gun, like the orginal German prototype, lacked reserve power and dependability under adverse field conditions—qualities possessed by the standard light machine guns of the United States, the models 1919A4 and 1919A6 and the automatic rifle M1918A2.

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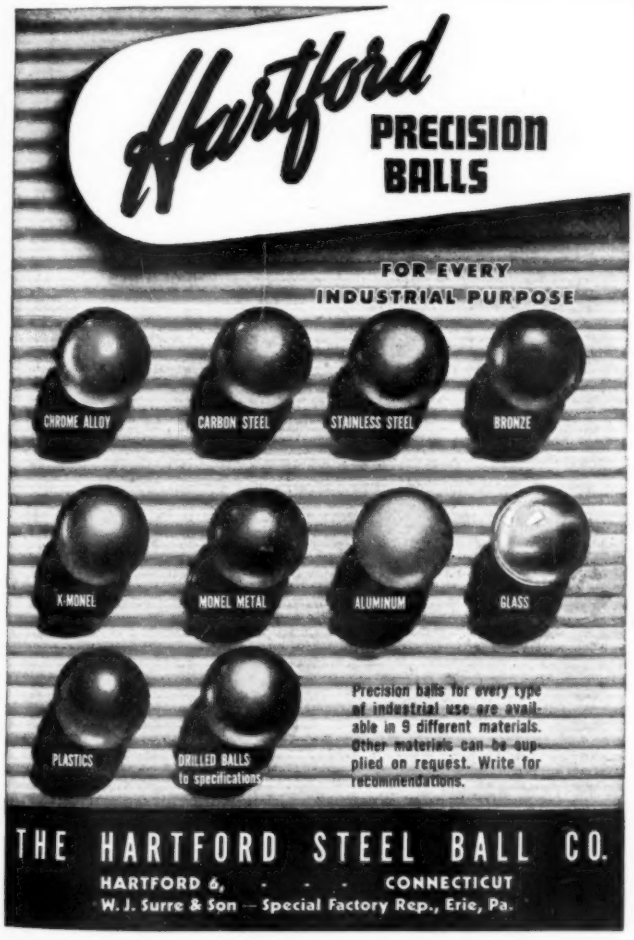

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THE PERILOUS FIGHT. By Neil H. Swanson. New York: Rinehart & Company. 555 pp. $3.50.

AFTER the British had burned Washington they proceeded to defeat a demoralized American army at Bladensburg in 1814. The remnants of our motley soldiery fled to Baltimore, the next major objective of the Redcoats who forthwith launched an amphibious assault on Maryland's key city. A strange but shrewd character named Samuel Smith, a veteran militia general and successful merchant, commanded the defense. He outthought and outfought the combined naval and landing operations.

Baltimore was saved, and the despairing American negotiators at Ghent obtained a fresh basis for favorable peace terms, but Americans know of this battle chiefly because one Francis Scott Key wrote some verses entitled "Defense of Fort McHenry." A judge named Nicholson noted that the lines could be sung to a "long-popular" air—"To Anacreon in Heaven."

A widow named Pickersgill had made an American flag for Fort McHenry which received an intense bombardment from the British fleet during a night attack. Despite a heavy dose from deadly mortar ships and other craft firing Sir William Congreve's not-too-accurate rockets, Key saw the "star spangled banner" as the sun arose.

The British general was shot by our snipers, and the British admiral finally withdrew in a most unhappy mood. No one has ever heard much about Sam Smith, and lawyer Key's verses, which very few Americans know word for word in full (go on, can *you* recite them all?), were the only memorial to a truly quite important battle which few realize they describe.

Now, however, comes author Neil H. Swanson with "The Perilous Fight," a magnificent and inspired history of the Baltimore battle, its background, its development, and its outcome in all phases. Mr. Swanson is clearly an expert historian, but he is even more a genius with his pen. Why he squanders his literary talents as managing editor of *The Baltimore Sun* is incomprehensible. Even so Mr. Swanson has already written several historical novels, including "The Judas Tree," "Forbidden Ground," "The Phantom Emperor," "The Flag Is Still There," and "The Silent Drum." His other history is entitled "The First Rebel."

THIS reviewer's only criticism of "The Perilous Fight" is its tendency toward somewhat tedious detail in the early chapters which provide an enlarged background for the pay-off battle. That, however, is merely an impression. Mr. Swanson is a portrait painter with the English language par excellence. The book could well be read for his style alone. It certainly should be read by all military students, and the general public ought to receive it as a top nonfiction item in the best-seller list.

The following is quoted from p. 374, representing the thoughts and impressions of battle-waiting troops. "The water bucket hanging underneath the limber of the cannon swung like a big bell dangling at a cow's neck. The trace chains made a dull tunk-tunking like a muffled bell, like a cow's bell when the cattle had been feeding in the marshes, leg-deep, to get away from the flies that plagued their udders, and the herd leader's bell had got plugged full of mud. It didn't sound warlike, it was just a sound that seemed to belong here.

"The sun-tawny lane and the brooding woodland were not meant for war—except an Indian war, maybe. But the Indians had been gone for a long time. There had been white people in

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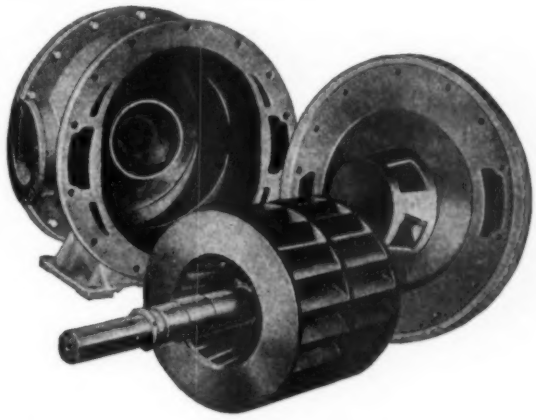

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Book Reviews

Maryland almost two hundred years; there had been people in Baltimore about a century. It seemed queer that after almost a hundred years there should still be woods as thick and wild as this, so close to Baltimore. It was remarkable how little difference it made whether there were people or not. They didn't change things much . . . only in spots, here and there . . . back yonder was Baltimore, the fourth biggest city in America, and here were woods just as they'd always been. People didn't get very far away from being wild . . .

"A sound clanged against the stillness. It was not a war sound. The first startled, broken-off note of the English bugle sounded like as if a bell cow, coming up out of a salt marsh, had struck her mud-filled bell against a stone. And then it sounded like the stone had jarred the mud out of the bell and scared the cow at the same time. The cow was running, the bell clanging crazily . . . not swinging, shaking . . . the clapper-bumps all ran together into one sound . . . the bugle up ahead was going crazy . . . the whole herd was running . . . you could hear the hoofs. The hoofbeats in the lane were soft explosions; they were like the bugle notes, all run together; they were one continuous cottony explosion, coming closer. Down the lane, a mass of horsemen exploded into sight."

A DESCRIPTION of rockets: "Again the harsh sound tears phlegm from a giant throat. More rockets leap into the air beyond Boulden's, they come in low arching flight, with a snarling whir, with smoke trailing behind them like legs, with fire blurring vague in the sun like the blur of wings beating too swiftly for seeing. They dart down into the woods, away off to the left again. You listen. But nobody screams. Nobody's been hit: a man gouged by a burning fence post would have to scream. It's all right, the rockets are harmless, they're only intended to scare you. Even if that were true, the truth would be hard to believe. And it isn't true.

"The rockets that jump and fly like monstrous and horrible insects are leaving behind them a row of 'coons from which they sprang. The cocoons are long metal tubes; they, themselves, look like enormous insects; they, themselves, look as if they were going to spring. They crouch low to the ground on four legs, on two pairs of stiff spraddled legs. One pair is short; set close to the tail of the long, hollow body, it lifts the rear end of the tube not quite to the height of a soldier's knee. The other pair, close to the opposite end, raises the head of the tube not quite to the height of his hip. The metal tube, with its two unequal bipods, is known as a *bouche à feu*. A hundred and thirty years hence it will go into battle again; it will lose its legs, but otherwise it will look very much the same. Even its name will look much the same—not *bouche à feu* but *bazooka*."

A description of the soldier reloading his piece: "Hand to the cartridge box. Bite through the paper. You can't taste the powder, your tongue's dry as powder, you couldn't spit if you tried. Prime. Shut pan. Cast about. Cast the butt of your gun to the front and left side . . . let it slide through your hand. Butt to the ground in front of your left foot. Right hand to the muzzle. Load. Raise the elbow as high as the wrist . . . pour the powder into the muzzle . . . shake the cartridge, get the last grains . . . force the empty cartridge paper into the muzzle. Draw ramrod. Seize it with thumb and forefinger . . . push it up briskly about a foot . . . keep your thumb pointing upward. Reverse the right hand . . . keep the back of your hand to your face, little finger on top . . . seize the rod, draw it clear . . . reverse it, turn its head outward and down . . . *there's so much to do and it takes so long and they're coming, the brown ghosts are big in the smoke now, they're solid, the brown wall is coming to crush you* . . .

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York Craftsmanship made possible the story above—the same Craftsmanship that was for over five years devoted almost 100% to the manufacture of guns, gun mounts, tank parts, fuzes, shells, and many other Ordnance items for the U. S. Army and Navy.

To Friends, New and Old, York is proud to relate the impregnability of the York vault in Manila—Happy to announce the return to York Quality Bank Vault Equipment Production, including Bank Vault Doors, Linings, Safe Deposit Boxes, Lockers, Night Depositories, and Related Equipment.

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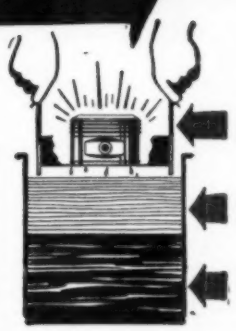
FOR CARBON DEPOSITS, OIL VARNISH, CLOGGED OIL LINES
FUEL PUMPS, CARBURETORS, OIL COOLERS, FUEL INJECTORS

Gives a Complete Strip
—not a strip tease
HARMLESS TO ALL METALS
Tough on Tar, Carbon

GUNK has been doing an outstanding job for the Army and Air Forces. Exceeds latest Government degreasing and decarbonizing specifications.

Thoroughly strips gasoline, gums, lead, and paint. Restores both base metal and small brass control screws, jets, valves, etc., to original factory-bright appearance. No etching . . . . no loss of dimensions, discoloration or harmful effect to metal parts. Gunk Dunk comes ready to use with Patented Dunking Screen in 5-gallon container—a complete decarbonizing package outfit.



GUNK Dunk is easy to use

The dunking screen that comes with the kit

The hydro-seal—a water base blanket that forms on top like cream on milk and prevents evaporation of concentrate, rinses work

GUNK (H-S) DUNK, digests carbon, gum

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INDEX TO ARMY ORDNANCE, VOLUME XXIX

The Index to Volume XXIX of ARMY ORDNANCE, with title page for binding, is available to all readers. It covers subjects in the following 1945 issues: July-August (No. 151), September-October (No. 152), and November-December (No. 153). It is arranged alphabetically by subject and author. Copies may be obtained, free of charge, upon written request.

THE ARMY ORDNANCE ASSOCIATION
705 MILLS BUILDING • WASHINGTON 6, D.C.

Book Reviews

first two fingers. Hurry . . . hurry . . . ram down. Tap the heel of the butt on the ground to level the powder. Ram the wadding well down the barrel. Return ramrod. Poise. Present. Aim . . . The sweat blurs your eyes. You can't see the front sight for the sweat and the smart of burned powder that flashed from the pan that last shot. But you can see the brown wall turning red, coming out through the smoke. *Fire.* . . . They've stopped! By God but they have! We've stopped 'em!"

A DESCRIPTION of Fort McHenry: "Fort McHenry was not merely a fort. It was not solely and exclusively a concentration of artillery walled in by permanent defenses. It was a small town, with a village green and story-and-a-half red-brick houses for its population. Life went on within it. There were women, carpenters, and blacksmiths. There were clerks, sick men, a doctor, and nurses (but no women tolerated). Also, there were cooks, bakers, and people who washed clothes and mended them, wiped dishes and made beds and emptied slops. There were rail-fenced gardens. Horses cropped the grass in pastures. Haystacks wandered across fields of stubble.

"The place also was an anachronism, a survival, a vestigial appendage of a way of life, a hyphen between past and present. It was a medieval walled town whose chief function was survival. It was at the same time the pleasant suburb of a modern city, suitable for family excursions of a Sunday—a quite normal place with certain mildly curious customs and a fine view of the river. It was a pentagon. From the higher ground, as you drove toward it out the 2-mile dirt road from Baltimore, it looked like a big 5-pointed star that had fallen neatly and precisely on the tip of Whetstone. On hot summer days, with the sun burning on the red-brick walls and the heat haze shimmering, the star looked as if it had not yet quite cooled."

Sam Smith's soliloquy during which he figures out what the British will do and plans to anticipate them is another of the book's many highlights. Sam had plenty of trouble, too, handling the War Department. They ordered him just before the battle to return his Government-owned field guns. Sam was too smart to reply that he needed the guns to fight a war. He replied instead that the War Department guns were mounted on Baltimore-owned gun carriages. Hence he had no available means of returning the *guns* at that time.

"The Perilous Fight" is more entertaining than many historical novels, yet it retains the essential advantage of being a history, an account of actual events.

Sam Smith and his Baltimore brigades will not know of this fine memorial to their deeds, but they could have asked no better tribute. The reader will find no better treatment of history.

BOOKS RECEIVED

ATOMIC ARTILLERY AND THE ATOMIC BOMB. By J. K. Robertson. New York: D. Van Nostrand Company. 173 pp. $2.50.

SPANISH HANDBOOK. By Lawrence F. Hawkins. New York: Cornell Maritime Press. 209 pp. $2.50.

101 WAYS TO BE YOUR OWN BOSS. By Michael Gore. New York: Arco Publishing Company. 128 pp. $1.

THE BASIC MANUAL OF MILITARY SMALL ARMS. By W. H. B. Smith. Harrisburg: Military Service Publishing Company. 351 pp. $5.

CARGO DEADWEIGHT DISTRIBUTION. By Martin Heuvelmans. New York: Cornell Maritime Press. 86 pp. $1.50.

PATTON: FIGHTING MAN. By William Bancroft Mellor. New York: G. P. Putnam's Sons. 245 pp. $3.

THE GREAT PACIFIC VICTORY. By Gilbert Cant. New York: The John Day Company. 422 pp. $3.50.

I'VE HAD IT. By Col. Beirne Lay, Jr. New York: Harper & Brothers. 141 pp. $2.

FIGHTING DIVISIONS. By CWO E. J. Kahn, Jr., and T/Sgt. Henry McLemore. Washington: *Infantry Journal*. 218 pp. $2.50.